

Origin V75 User's Manual

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Origin Basics

The Origin Workspace

Windows

Opening a New Child Window

Origin child windows are created using templates. The **New Worksheet** button , for instance, creates a worksheet based on the ORIGIN.OTW template.

Child Window Templates:

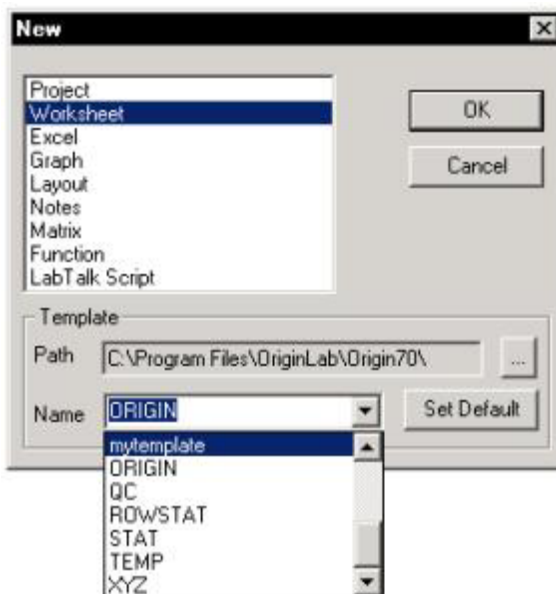
- Open a new window based on a default template.

1. Click one of the **New Window buttons** on the Standard toolbar.



or

1. From the menu, select **File: New**.
 2. Select the desired **Window** type in the list box. The **Template** group registers the **Path** and **Name** of the default template file for window type **Window**.
 3. Click **OK**.
- Change the (default) template that is associated with one of these Standard toolbar buttons.
 1. Select **File:New**. This opens the **New** dialog box.
 2. Select the window of type **Window** from the list box.
 3. Select the desired template from the **Template** group.
 4. Click **Set Default** to associate this template with the **New Window** button on the Standard toolbar.



- Save a custom child window as a template.
 1. Click on the child window to ensure that it is the active window.
 2. From the menu, select **File: Save Template As...**
 3. Choose the **Save In** folder, give the template a **File Name**, and **Save as Type** (*.OTW, *.OTP, *.OGM, etc.).
- Save a custom child window using the **Path** and **Name** of the default template.
 1. Select **File: New**.
 2. Select window of type *Window*.
 3. Note the **Path** and **Name** (Template group). This is the default template of type *Window*.
 4. Close the **New** dialog by clicking **Cancel**.
 5. Click on the window of type *Window* that you want to save as your default template.
 6. Choose **File: Save Template As...**
 7. Save the child window using the default **WindowPath** and **Name**.
- Save a custom child window using a new **Path** and **Name** and specify this file as your default *Window* template.
 1. Click on your custom child window to make sure that it is the active window.
 2. Choose **File: Save Template As...**
 3. Choose the **Save In** folder, give the template a **File Name**, and **Save as Type** (*.OTW, *.OTP, etc).
 4. From the Origin menu, choose **File: New...**
 5. Select the window of type *Window*.
 6. Click the button to the right of **Path**.

7. Browse to the **Folder Name** that contains your recently saved template file and click **OK**.
8. Choose the **Name** of your custom template from the drop-down list and click **Set Default**.
9. Click **OK**. Origin will now use this template as the default template of type **Window**.


Other Child Window Operations:

- Move or resize a window.

- ⇒ To move a window, drag the window title bar.
- ⇒ To manually resize a window, drag a corner of the window with your mouse.
- ⇒ To maximize a window, click the maximize button in the upper-right corner of the window.
- ⇒ To minimize a window, click the minimize button in the upper-right corner of the window.

- Hide or Delete a window.

To hide or delete a window:

1. Click **Close**  in the upper-right corner of the window. An attention dialog box prompts you to **Delete** or **Hide** the window (or to **Cancel** the action).
2. Click **Hide** to remove the window from the workspace (window not deleted from the Origin project).

or

2. Click **Delete** to permanently remove the window from the Origin project.

Alternately:

1. Right-click on the window icon in Project Explorer and choose **Hide Window** or **Delete Window** from the shortcut menu.

or

1. Toggle between **Show Window** and **Hide Window** by double-clicking the window icon in Project Explorer.

- Duplicate a window.

1. From the Origin menu, choose **Window: Duplicate**.

or

1. On the Standard toolbar, click **Duplicate** .

- To rename or add a label to a window, see *Renaming a Window* on page 3.

Renaming a Window

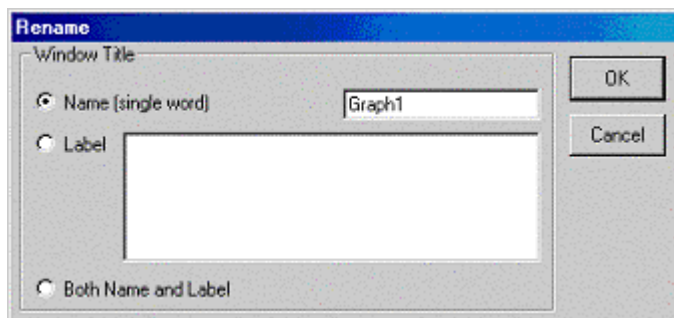
To rename a worksheet, matrix, graph, layout page, or notes window:

1. Activate the window and then select **Window:Rename**.

or

1. Right-click on the window's title bar and select **Rename** from the shortcut menu.

Both actions open the **Rename** dialog box. Use this to rename or label (or both) the child window.



Rules for assigning worksheet names and labels:

window **names**...

- must be unique.
- cannot contain spaces.
- must begin with a letter.
- cannot contain special characters (i.e., @, #, %, etc.).
- are limited in length -- worksheet or matrix = 13 spaces; graph, function, or layout = 24 spaces.
- do not allow spaces between characters.

window **labels**...

- do not have to be unique (note that Origin uses the window *name* to id the window).
- may contain spaces.
- are not limited in length.
- allow special characters.

To rename an Excel workbook window, see *Renaming the Workbook* on page 446.

Duplicating a Window

To duplicate the active worksheet, graph, matrix, or layout page window, click the **Duplicate** button



on the Standard toolbar. When a duplicate window is created, Origin names the window using the default window name syntax ...

DefaultWindowNameN

... where *N* is assigned the lowest available number not used by other window names (of the same type) in the project.

Default Window Names

Window	Default Name
Worksheet	WorksheetN
Graph	GraphN
Matrix	MatrixN
Layout Page	LayoutN
Function Graph	FunctionN




Refreshing a Window

Whenever you change the contents of a graph window or a worksheet, or expose a part of a window that was hidden, Origin automatically redraws the affected portion of the window. Occasionally, a portion of the window may not draw or update correctly.

Whenever this occurs, click the Refresh button  on the Standard toolbar to refresh the active window.

Note: To control the percentage of the window that must be exposed before Origin automatically redraws the window, select **Tools:Options** to open the Options dialog box. Select the Miscellaneous tab and then edit the No Redraw (% Covered) combination box.

Window Templates

When you create a new worksheet, graph, or matrix window, (for example, by clicking the , , or  button on the Standard toolbar), Origin creates the new window based on a **template**. The template determines the properties of the new window. For example, if the new window is a worksheet, the template determines the number of columns in the worksheet, each column's plotting designation and display type, the ASCII import settings, and any formulas used to set the column values. If the new window is a graph, the template determines the number of layers (sets of XY axes) on the page and their arrangement, the types of data plots in each layer (for example, scatter or bars), the number of data plots, the axes scale type, and text labels and other annotations. Basically the template determines all the attributes of the window, except for the actual data the window will contain.

Note that data are **not** saved with a template.

File Extensions for Origin Child Window Templates:

Window	Template File Extension
worksheet	.OTW
graph	.OTP
matrix	.OTM

Worksheets

The worksheet is a type of Origin child window that serves primarily to organize your data. Data manipulation, exploration, and analysis operations are frequently performed in the worksheet. As with other Origin child windows, you may open and save multiple worksheet windows in your Origin project file.

When you run Origin, the workspace that opens contains, by default, a single Origin worksheet. This single, default Origin worksheet is constructed using a named Origin worksheet template -- ORIGIN.OTW.

All Origin worksheets are based on a customizable worksheet template (.OTW) file. In addition to simple format options (e.g. page color, column width, font, etc.), worksheet templates can store file information regarding:

- Data file import format (no. of header lines, separator, data format, etc.).
- Column formulae for performing math operations on datasets and extracting data that meet specific criteria.
- LabTalk scripts that perform a custom routine when triggered by a specific event (e.g. a button click, window refresh, etc.).

Graphs

The primary purpose of the graph window is to plot data. As is the case with worksheets and other Origin child windows, you may open and save multiple graph windows in an Origin project file.

Each graph window is comprised of a single editable page. This page may contain various graph objects including layers, axes, annotations and data plots. Information on the graph page is organized hierarchically.



The graph window (the page) may contain one or more graph layers and each graph layer may contain one or more data plots. Annotations (text and drawing objects) may be attached to the page or to a layer. To learn more about graph layers, see *Defining the Layer* on page 239.

All Origin graphs are based on built-in graph template files. The graph template stores information about graph page size, number of graph layers, axis configuration(s), plot style(s) and colors, etc. Use of these template files simplifies graph creation; many graphs are created with a simple, two-step process.

1. Select your data in the Origin worksheet.
2. Click the appropriate graph toolbar button.

You can modify the details of any of these built-in graph templates and save your changes or you may modify a built-in template and save it with another name.

Matrices

The matrix window, like the worksheet window, is used to store and manipulate data. The matrix is a prerequisite for creating 3D surface and contour plots as well as image plots.

A matrix displays a single data set composed of Z values. Instead of displaying the data set as a column in a worksheet, a matrix displays the data as a 2D array (rows by columns). The matrix is...

- linearly mapped in X by columns.
- linearly mapped in Y by rows.

By default, the column and row numbers display in the column and row headings.

To display X and Y values:

1. Click on the matrix window to activate it.
2. Select **View:Show XY**.

The image displays two screenshots of the 'Matrix1' window in Origin software. The top screenshot shows a 6x4 matrix with columns labeled 1, 2, and 3. The bottom screenshot shows the same 6x4 matrix with an additional column labeled 4, and the first column is now labeled with values 1.29032, 1.58065, 1.87097, 2.16129, and 2.45161.

	1	2	3
1	1.38177	1.50123	1.54025
2	1.11828	1.23774	1.27676
3	0.83162	0.95108	0.9901
4	0.54579	0.66524	0.70427
5	0.2847	0.40415	0.44318
6	0.07021	0.18967	0.22869

	1	1.29032	1.58065
1	1.38177	1.50123	1.54025
1.29032	1.11828	1.23774	1.27676
1.58065	0.83162	0.95108	0.9901
1.87097	0.54579	0.66524	0.70427
2.16129	0.2847	0.40415	0.44318
2.45161	0.07021	0.18967	0.22869

XYZ worksheet data are frequently converted to matrix data. Origin uses a number of methods for converting worksheet data to matrix data depending upon the nature of the worksheet data. These methods include direct conversion, 2D binning, converting regular XYZ data, and converting random XYZ data using gridding.

To open a new matrix:

1. Select **File:New**. This menu command opens the **New** dialog box.
2. Select **Matrix** from the **Window Type** list box.
3. Select **Origin** from the **Template** drop-down list.
4. Click **OK** to open a matrix window based on the ORIGIN.OTM template.

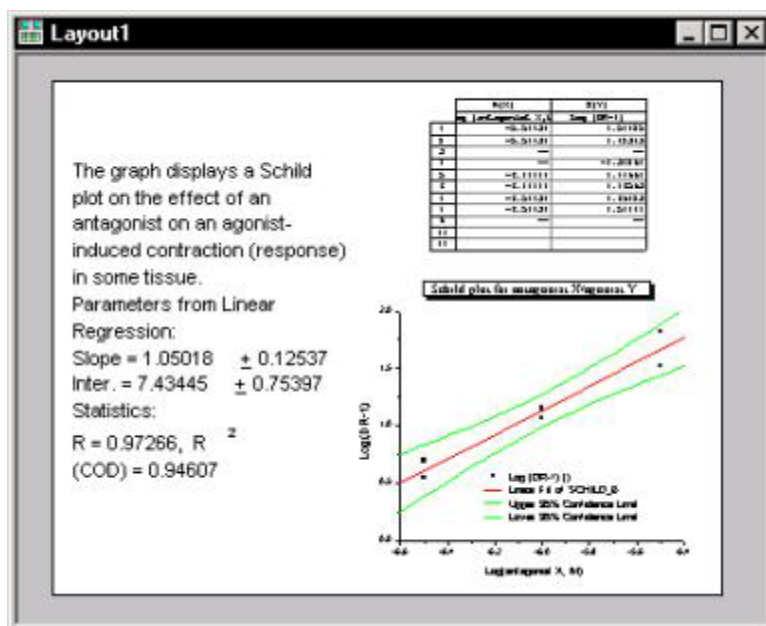
To open a previously saved matrix window:

1. Select **File:Open**.
2. Select **Matrix (*.OGM)** from the **Files of Type** drop-down list.
3. Select the file and click **Open**.

Layout Pages

The layout page window is a “display panel” for graphs and worksheets that have been created in other windows. You can add and arrange worksheets, graph pictures, and text and other annotations to your layout page to create presentations for print, for graphic export, or for sharing with other applications via the Windows Clipboard.

A Layout Page Window




To open a layout page window.

1. Select **File:New**. This menu command opens the New dialog box.
2. Select **Layout** from the **Window Type** list box.
3. Click **OK** to close the dialog box and open the layout page window.

Layout page windows are named Layout1, Layout2, etc.

To learn more about creating presentations with the Layout Page window, see *The Layout Page* on page 426.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Function Graphs

The function graph window is a customized graph window providing graphical display and manipulation of functions. The user-defined function must be of the form $y = f(x)$.

To learn more about function graphs, see *Plotting Functions* on page 173.

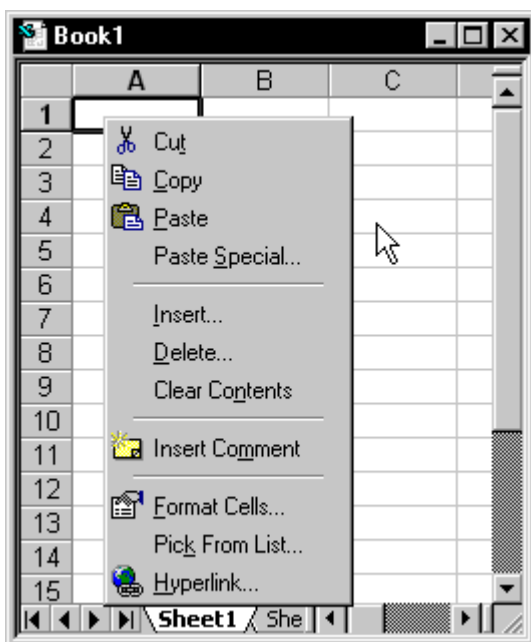
The Excel Workbook Window

The ability to open and edit Excel workbooks in Origin brings Origin's technical plotting capabilities to Excel spreadsheets. To make use of this feature, you must meet these minimal requirements.

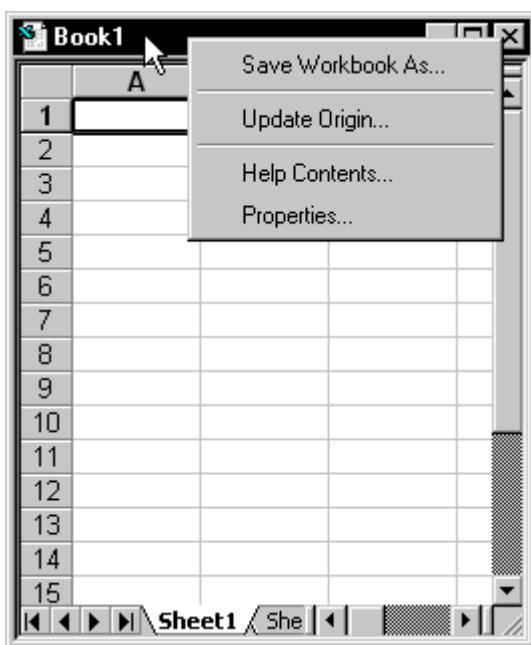
When the Excel workbook window is active in Origin, a composite menu bar displays Origin's **File**, **Plot**, and **Window** menus plus Excel's **Edit**, **View**, **Insert**, **Format**, **Tools**, **Data**, **Accounting**, and **Help** menus. Likewise, a combination of Excel and Origin toolbars are available.

Shortcut menus pertinent to the Excel workbook window also provide menu command access:

- A Right-click *in* the workbook window opens an Excel shortcut menu.



- A Right-click *on the title bar* of a workbook window opens an Origin shortcut menu.

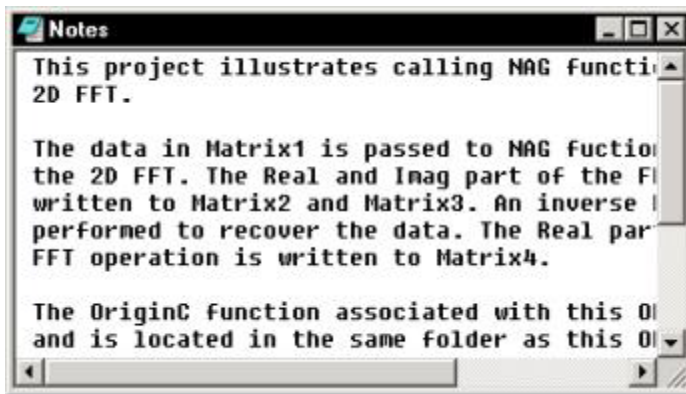


Notes Windows

Notes windows are text-only windows used for recording information. Use them for:

- recording analysis procedures.
- making notes to students and colleagues.

- cutting and pasting text to and from other applications.



An Origin project file can have any number of notes windows. You can save the contents of notes windows with the Origin project file or you can save the contents of a notes window as a TXT file.

To save your notes as a text file:

- Click on the notes window to activate it.
- From the menu, choose **File:Save Notes As**.
- Choose **Text File (*.TXT)** from the **Save As Type** drop-down list, enter a **File Name**, and **Save**.

Menus

Menus by Window Type

Active Window	Menu Structure
worksheet	File Edit View Plot Column Analysis Statistics Tools Format Window Help
graph	File Edit View Graph Data Analysis Tools Format Window Help
matrix	File Edit View Plot Matrix Image Tools Format Window Help
Excel workbook	<p>Origin Menus</p> <p>When an Excel window is active in Origin, the menu bar displays both Origin and Excel menus. The File, Plot, and Window menus are Origin menus. All other menus are Excel menus.</p> <p>See, <i>Excel Workbook Shortcut Menus</i> on page 444.</p>
layout	File Edit View Layout Tools Format Window Help
notes	File Edit View Tools Format Window Help

Toolbars

The Standard Toolbar



opens a new Origin project. If current project edits are not saved, you are prompted to save your changes.



opens a new worksheet window based on the default worksheet template.



opens a new Excel workbook window.



opens a new graph window based on the default graph template.



opens a new matrix window based on the default matrix template.



opens a new function graph window and simultaneously opens the Function tab of the Plot Details dialog box.



opens a new layout window.



opens a new notes window.



opens the **Open** dialog box (Generic: OPJ, ORG, OGW, OGG, OGM, TXT, etc.).



opens the **Open** dialog box (Specific: OTP, OTW, OTM).



opens the **Open** dialog box (Specific: XLS).



saves the Origin project file.



saves the active window with the name of the template upon which the window is based.



opens the **Import ASCII** dialog box (TXT, DAT, CSV, *.*).



opens the **Import Multiple ASCII** dialog box (TXT, DAT, CSV, *.*).



sends the active window to the printer *without* prompting; the current **Page Setup** and default printer settings are used.



refreshes the active window.



duplicates the active window.



calls the [Main] section of the editable LabTalk script file, CUSTOM.OGS. [Main] can be your own analysis/graphing routine.



toggles Project Explorer on and off.



toggles the Results Log on and off.



toggles the Script Window on and off.




opens Code Builder, the Origin C Integrated Development Environment (IDE).



adds a new column to the end of the active worksheet.

The Graph Toolbar



zooms in on the graph, centering on the point where you right-click with your mouse (to restore, click ).



zooms out.



restores the graph to the whole page view.



rescales the axes to show all data points. Useful for restoring the graph after using the **Enlarger Tool**



to enlarge a portion of the graph axis.



extracts data plots in the active layer to separate layers.



extracts all layers in the active graph window to separate graphs.



merges all open graph windows onto a single graph page. Graphs may be superimposed or merged as separate panels.



creates a color scale for 3D contour plots and color mapped surfaces.



generates a new graph legend. Primarily useful after adding data plots to a single layered graph.



adds a moveable, sizable scale object to the active graph.




adds the system time and date to your graph window.

The Format Toolbar





 sets the text label font.

 sets the text label font size.


 bold.

 italic.


 underline.


 superscript.

 subscript.

 super/subscript.

 Greek letter (Default = TT Symbol Font).

 increase font size.

 decrease font size.

Note: Text color control is available from the **Style** toolbar.

For more information on formatting text labels, see *Creating and Editing Text Labels* on page 388.

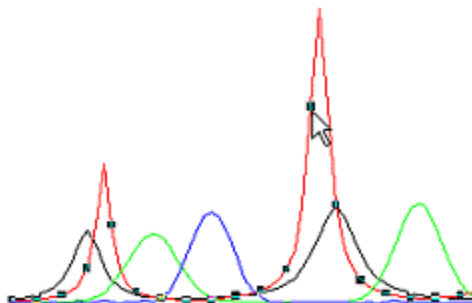
The Style Toolbar



The Style toolbar is useful for formatting text labels and other annotations as well as data plot attributes (line style, line color, symbol color, fill pattern, etc.).

Notes on use of the **Style** Toolbar to edit plot attributes

To use the Style toolbar for editing plot attributes, you must first click on the data plot and select it. Note the "handles" on the selected data plot.



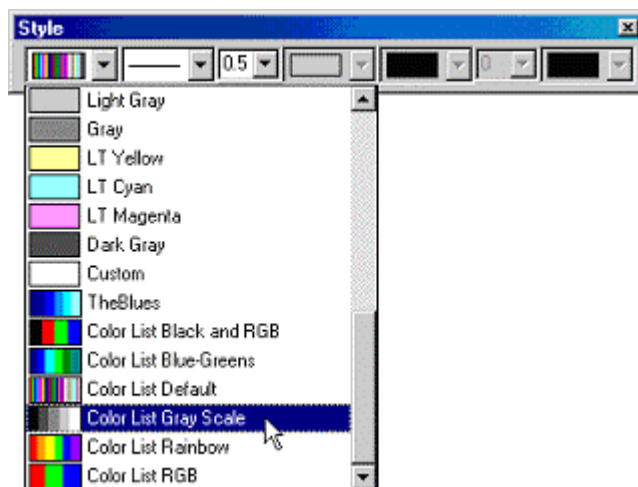
- For ungrouped datasets, clicking on a single data plot selects just that data plot.
- To select multiple ungrouped data plots, hold down the SHIFT key while selecting plots to edit.
- For grouped data plots, clicking on any data plot in the group selects the entire group.

Once a data plot or a plot group has been selected, you can edit various attributes of the plot -- symbol color, line style and width, fill patterns, incremental color lists for grouped data plots -- using the Style toolbar. This avoids having to open the Plot Details dialog box.

Note that not all plot attributes can be edited with the Style toolbar (for example, to change plot symbol type, you need to open the Plot Details dialog box).

For grouped data plots, incremental color schemes can be applied:

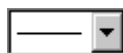
1. Click to select the entire plot group.
2. Open the **Color** drop-down list, scroll to the bottom of the list and choose an incremental color scheme.



Origin ships with some ready-to-use incremental color schemes. These are actually a type of Theme (see, Creating Themes). To learn how to create a new incremental color list, see Group Incremental Color Lists on page 319.



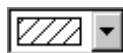
sets the font/line/border color of the selected object.



sets the line/border style of the selected object.



sets the line/border width (pt. size) of the selected object.



sets the fill pattern of the selected 2D object.



sets the fill color of the selected 2D object.



sets the fill pattern width of the selected object.



sets the fill pattern color of the selected object.

The Tools Toolbar



The Tools toolbar provides text, arrow, line, and other annotation buttons. It also provides buttons to enlarge a region of a graph.



used in the default object selection mode.



enlarges a portion of the axis scale.



restores the axis scale values to their previous **From** and **To** values.



read the XY (and Z, if 3D or contour) location on the page.



read the XY (and Z) location of a data point.



define a range of data.



draw a data plot.



creates text objects.



creates arrow objects.



creates curved arrow objects.



creates line objects.



creates a rectangle.



the Rectangle tool in "region of interest" mode. Use it to select a region of the image to crop, copy, or duplicate. The region of interest mode is controlled from the **Tools:Show Tools as ROI** menu command.



creates a circle/ellipse.



creates a polygon.



creates an freehand closed object (region). Click and drag to create a region; release the button to complete the object.



creates a polyline. Click once to create an anchor point; double-click to end the line.



creates a free form line. Click and drag to create a line; release the mouse button to end the line.

The 2D Graphs Toolbar

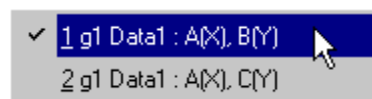


The 2D Graphs toolbar buttons are available when a worksheet, Excel workbook, or graph window is active. Buttons provide quick access to common 2D graph templates. The **Template** button opens the Template Library, providing access to built-in and custom graph templates.

To use the Graphs toolbar buttons:

- When a worksheet or Excel workbook is active, select the data that you want to plot, then click a button on the 2D Graphs toolbar to plot your data.
- When a graph window is active, you can change the graph type (for example, from a scatter plot to a column plot) for the active data plot. To activate a data plot:

- Select the data plot from the **Data** menu.



- Click the button on the 2D Graphs toolbar to change the graph type.



creates a line graph from the selected data.



creates a scatter graph from the selected data.



creates a line & symbol graph from the selected data.



creates a bar graph from the selected data.



creates a column graph from the selected data.



creates a pie chart from the selected data.



creates an area graph from the selected data.



creates a fill area graph from the selected data.



creates a polar graph from the selected data.



creates a ternary graph from the selected data.



creates a Smith Chart from the selected data.



creates a high-low-close chart from the selected data.



creates a XYAM (X,Y, angle, magnitude) vector graph from the selected data.



creates a XYXY (start X, start Y, end X, end Y) vector graph from the selected data.



opens the **Select Template** dialog box (Template Library).

The Edit Toolbar



cuts the selected data or object.



copies the selected data or object.



pastes the contents of the Clipboard.

The 2D Graphs Extended Toolbar



The 2D Graphs Extended toolbar buttons are available when a worksheet, Excel workbook, or graph window is active.



creates a vertical drop line graph.



creates a 2 point segment graph.



creates a 3 point segment graph.



creates a vertical step graph.



creates a horizontal step graph.



creates a spline-connected graph.



creates a double Y axis graph.



creates a line series graph.



creates a waterfall graph.



creates a zoom graph.



creates a scatter graph with Y error bars.



creates a scatter graph with X and Y error bars.



creates a stacked bar graph.



creates a stacked column graph.



creates a floating bar graph.



creates a floating column graph.



creates an indexed size (bubble) graph.



creates a color mapped graph.



creates a bubble + color mapped graph.



creates a box chart.



creates a QC (X-bar R) chart.



creates a histogram.



creates histogram + probabilities.



creates stacked histograms.



creates a vertical 2 panel graph.



creates a horizontal 2 panel graph.



creates a 4 panel graph.





















creates a 9 panel graph.



creates a stack graph.

The 3D Graphs Toolbar














-  creates a 3D scatter graph from XYZ worksheet data.
-  creates a 3D trajectory graph from XYZ worksheet data.
-  creates a 3D XYY bar graph from XYZ worksheet data.
-  creates a 3D ribbon graph from XYZ worksheet data.
-  creates a 3D wall graph from XYZ worksheet data.
-  creates a 3D waterfall graph from XYZ worksheet data.
-  creates a 3D color fill surface graph from a matrix of Z values.
-  creates a 3D X constant with base graph from a matrix of Z values.
-  creates a 3D Y constant with base graph from a matrix of Z values.
-  creates a 3D color mapped surface graph from a matrix of Z values.
-  creates a 3D bar graph from a matrix of Z values.
-  creates a 3D wire frame graph from a matrix of Z values.
-  creates a 3D wire surface graph from a matrix of Z values.
-  creates a 3D contour color fill graph from a matrix of Z values.
-  creates a 3D black and white contour graph from a matrix of Z values.
-  creates a 3D gray scale contour graph from a matrix of Z values.
-  creates an image plot from a matrix of Z values.
-  creates a profile plot from a matrix of Z values.

The 3D Rotation Toolbar



The 3D Rotation toolbar is available when a 3D graph is active (worksheet- or matrix-derived). Toolbar buttons rotate the graph and change the perspective.









-  Rotate counterclockwise about the Z axis the specified rotation angle.
-  Rotate clockwise about the Z axis the specified rotation angle.
-  Tilt the top of the graph counterclockwise the specified rotation angle.
-  Tilt the top of the graph clockwise the specified rotation angle.
-  Rotate downward about the X axis the specified rotation angle.
-  Rotate upward about the X axis the specified rotation angle.
-  Increase the perspective angle by 3 degrees.
-  Decrease the perspective angle by 3 degrees.
-  Fit the graph to the layer frame.
-  Reset the rotation angles.
-  Select or type a rotation angle (in degrees) for the rotation buttons.

For more information, see *Controlling the 3D Axis Length, Rotation, and Perspective in a Layer* on page 310.

The Worksheet Data Toolbar



The Worksheet Data toolbar buttons perform statistics on columns or rows of data, sort columns of data, use functions to set column values or mathematically transform data, update these column values, and fill columns with row numbers or random numbers.

-  calculates descriptive statistics on selected columns.
-  calculates descriptive statistics on selected rows.
-  opens the **Nested Sort** dialog box.
-  opens the **Set Column Values** dialog box.
-  updates all worksheet column values.
-  fill selection range with row numbers.
-  fill selection range with uniform random numbers.
-  fill selection range with normal random numbers.

The Column Toolbar



The Column toolbar is available when a worksheet column is selected. It provides buttons to set the column plotting designation and to move columns.



designates the selected column(s) as X.



designates the selected column(s) as Y.



designates the selected column(s) as Z.



designates the selected column as a Y error bar column.



designates the selected column as a label column.



designates the selected column(s) to be disregarded.



moves the selected column to the first worksheet column position.



moves the selected column one column to the left.



moves the selected column one column to the right.



moves the selected column to the last worksheet column position.

For more information, see

- *Designating a Column as X, Y, Z, Error, Label, or Disregard* on page 46.
- *Arranging the Worksheet* on page 39.

The Layout Toolbar



Use the Layout page buttons to add pictures of graphs or worksheets to the layout page.



opens the **Select Graph Object** dialog box.



opens the **Select Worksheet Object** dialog box.

For more information, see *Error! Reference source not found.* on page 430.

The Mask Toolbar



Use the Mask toolbar to mask worksheet or graph data from analysis.



activates the **Data Reader** tool on the Tools toolbar. Toggle masking on/off for a single point in your graph.



activates the **Data Selector** tool (Tools toolbar), when a graph is active; select a range of data to be masked. If a worksheet is active, clicking this button masks the selected worksheet data.



activates the **Data Selector** tool (Tools toolbar), when a graph is active; select a range of masked data and remove the mask. If a worksheet is active, clicking this button removes the mask from the selected worksheet data.



applies mask to data that is currently *unmasked* and *removes* masking from data that is currently masked (graph only).



changes mask color (worksheet or graph).



hides/shows masked points (graph only).



enables/disables masking (worksheet or graph).

For more information, see *Adding a Graph or Worksheet Picture to the Layout Page Window* on page 426.

The Object Edit Toolbar



The Object Edit toolbar is available when one or more annotation objects are selected in the active window, or when more than one picture is selected in a layout page. The toolbar provides buttons to align the selected objects/pictures, and to change the drawing order of the objects/pictures. Buttons are provided to group objects so that you can move or align the group. Additionally, buttons are provided to change the drawing order of objects relative to data plots.



aligns selected objects along the left edge of the last-selected object.













aligns selected objects along the right edge of the last-selected object.



aligns selected objects along the top edge of the last-selected object.



aligns selected objects along the bottom edge of the last-selected object.







-  aligns selected objects vertically along the vertical axis of the last-selected object.
-  aligns selected objects horizontally along the horizontal axis of the last-selected object.
-  adjusts the horizontal dimension of selected objects to that of the last-selected object.
-  adjusts the vertical dimension of selected objects to that of the last-selected object.
-  brings the selected object(s) to the front.
-  pushes the selected object(s) to the back.
-  draws the selected object(s) in front of the data.
-  draws the selected object(s) in back of the data.
-  group the selected objects.
-  ungroup the selected objects.

For more information, see *Arranging and Aligning Objects* on page 407.

The Arrow Toolbar

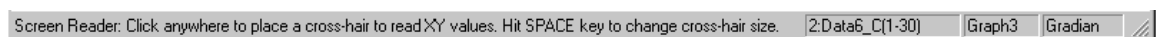


Use the Arrow toolbar to align multiple lines/arrows, and to customize the arrow head.

-  aligns the selected lines/arrows horizontally.
-  aligns the selected lines/arrows vertically.
-  widens the arrow head of the selected object.
-  narrows the arrow head of the selected object.
-  lengthens the arrow head of the selected object.
-  shortens the arrow head of the selected object.

For more information, see *Drawing Lines and Arrows* on page 400 and *Arranging and Aligning Objects* on page 407.

The Status Bar



The status bar displays:

- The name of the System Theme, if any exists.
- Descriptions of Origin and Excel tools.
- Information pertinent to the active window, including:
 - ⇒ worksheet (*column number:dataset(rows), window name, angular units*).
 - ⇒ Excel workbook (*workbook name, angular units*).
 - ⇒ graph (*data list number of active data set:data set(rows) or matrix window name, graph window name, angular units*).
 - ⇒ matrix (*window name, matrix dimensions, matrix window name, angular units*).
- Angular Units (radians, degrees, or gradians).

Project Explorer

Display of Project Explorer

When you first start Origin, Project Explorer displays docked to the bottom edge of the workspace. You can dock it to any other edge or float it in the workspace. To prevent Project Explorer from docking when positioning it as a window, press CTRL while dragging.

Because Project Explorer uses some of your workspace, you may want to close Project Explorer, even if you have already created a folder structure. To close Project Explorer:

1. Click the **Project Explorer** button  on the Standard toolbar.
- or
1. Press ALT + 1.

When Project Explorer is closed, Origin continues to use your folder structure and view settings to control the display of windows in your workspace. If you are working with a project that contains subfolders and the view mode is set to view only the active folder's windows, then Origin will display only the windows in the current folder.

Hiding a Window

To maximize the use of your workspace, you can hide windows from view - without deleting them from the project.

To hide a window in the workspace:

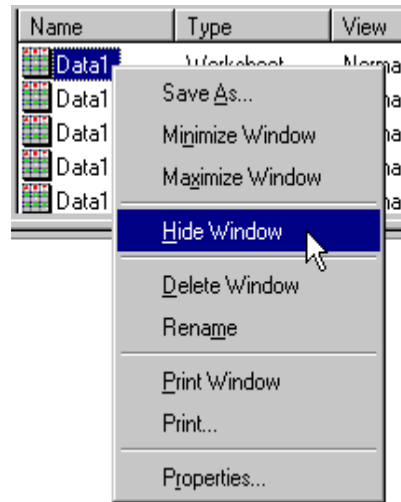
1. Select the desired window icon on the right side of Project Explorer and then double-click on this icon. Note that the icon is now grayed-out.

Name	Type	View	Name	Type	View
Raw D...	Folder		Raw D...	Folder	
ConvGr...	Graph	Normal	ConvGr...	Graph	Hidden
Notes	Notes	Normal	Notes	Notes	Normal

To return the window to the normal view mode:

1. Double-click on the grayed-out window icon.

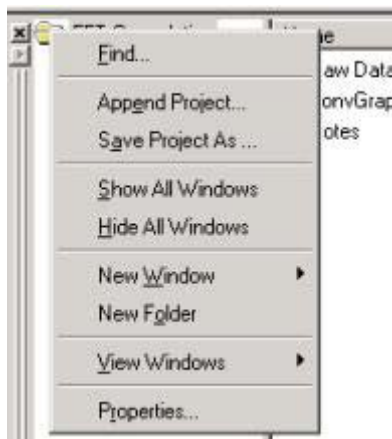
These view controls are also available by right-clicking on the window icon in Project Explorer, or by right-clicking on the window title bar.



Creating a New Folder

To create a new folder:

1. Right-click on the project folder (or a subfolder) on the left side of Project Explorer.
2. Select **New Folder** from the shortcut menu.

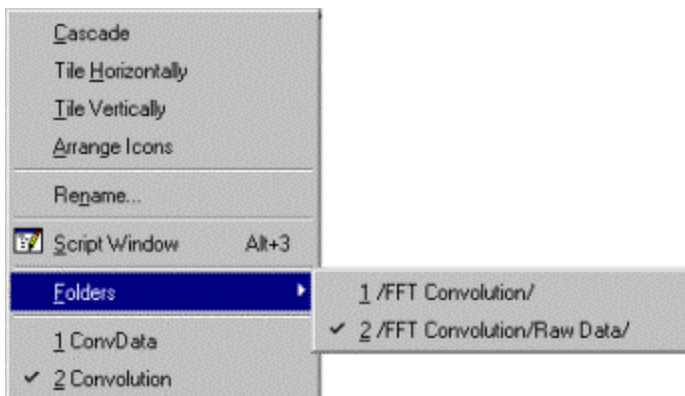


Once you have created one or more subfolders, you can move windows between folders.

To access windows in other folders:

1. From the Origin menu, select **Window:Folders:Folder Name** to view the windows in the selected Project Explorer folder. The window list at the bottom of the **Window** menu updates to reflect the windows in the **Folder Name** folder.

Accessing Folders and Windows from the Menu Bar



Controlling the View of Windows

In addition to adding and moving folders, Project Explorer also controls the view of your workspace. By default, only the windows in the active Project Explorer folder display in your workspace. This minimizes workspace clutter.

To control the view of the windows in your workspace:

1. Right-click on a Project Explorer folder or right-click in a blank space on the left side of Project Explorer.
2. Select **View:View Mode** to alter the view mode.

or

1. Select **View:View Windows:View Mode** from the Origin menu bar.



Finding Windows

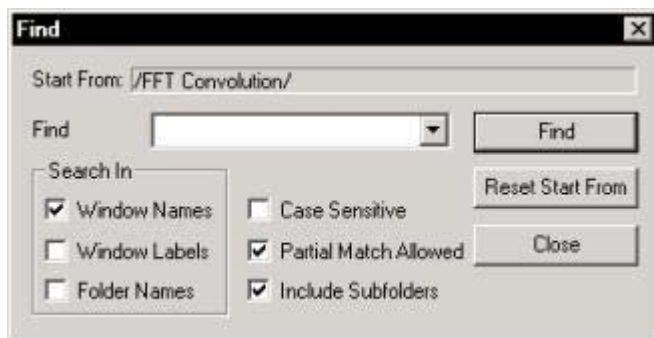
After you organize your windows into multiple folders, Project Explorer's **Find** dialog box helps you locate windows in your project.

To open this dialog box:

1. Right-click on the Project Explorer folder that you want to start your search from and select **Find** from the shortcut menu.

or

1. If you are unsure of the window location within your Project Explorer folder structure, right-click on the main project folder and select **Find**.



The Windows Dialog Box

If you have more than nine windows in your current Project Explorer folder and you want to view a window that is not currently listed in the window list at the bottom of the **Window** menu, select **Window:More Windows**. This menu command opens the **Windows** dialog box.

The Windows dialog box can be resized by dragging the edge of the dialog box. The dialog box displays the names (and/or labels), window type, and current status of all windows in the current Project Explorer folder, or the current folder and subfolders, depending on your Project Explorer viewing mode.

To activate a window:

1. Double-click on the window in the list box or click once on the window and click **Activate**.
 2. Click **Close** to close the dialog box and view the active window.
- To sort the windows alphabetically by name (or label) or by window type or state:
 1. Click the respective button (column heading) at the top of the list box.
 - To minimize or restore a window:
 1. Select the window from the list box.
 2. Click **Minimize Window** or **Restore Window**.
 - To close a window so that it is no longer part of the project:
 1. Select the window from the list box and click **Close Window**.
 2. To verify closure, click **Yes** in the **Attention** dialog box.

To disable the display of the **Attention** dialog box, select the **Disable Close Prompt** check box.

Results Log

Display of the Results Log

In most cases, when results are typed to the Results Log, it opens automatically. To manually open (and close) the Results Log:

1. Click the **Results Log** button  on the Standard toolbar.

or

1. From the Origin menu, select **View:Results Log**.

or

1. Press ALT + 2.

Opening and closing the Results Log only controls its view state. You do not lose results by closing the log.

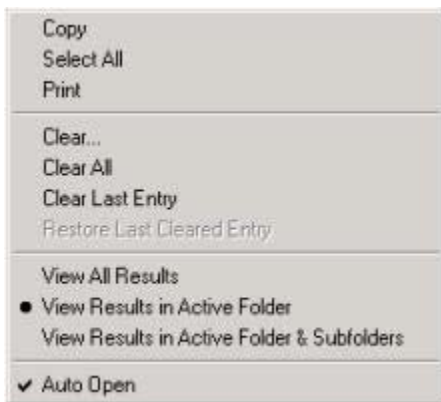
When the Results Log first opens, it displays docked to the bottom edge of the workspace. You can dock it to any other edge or display it as a window in the workspace. To prevent the Results Log from docking when positioning (floating) it as a window:

1. Press CTRL while dragging the Results Log.

Note: When you close the Results Log after it has been docked to the edge of the workspace, the toolbar region may display a blank area where the log was located. To hide this spacer, right-click in this region and select **Hide Toolbar Spacer** from the shortcut menu.

You can right-click in the Results Log to open a shortcut menu with commands to copy, print, clear, and view additional results.

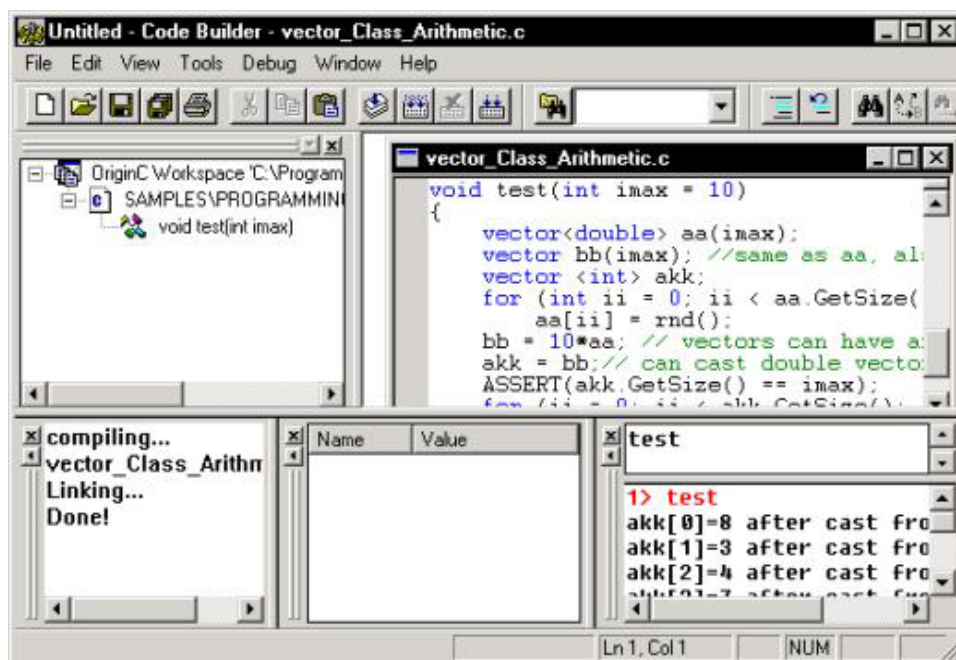
The Results Log Shortcut Menu



Code Builder

Origin's programming language is called Origin C. Origin C supports a nearly complete ANSI C language syntax as well as a subset of C++ features including internal and DLL-extended classes. In addition, Origin C is "Origin aware". This means that Origin objects such as worksheets and graphs are mapped to classes in Origin C, allowing direct manipulation of these objects and their properties from Origin C.


Origin C's integrated development environment (IDE) is called Code Builder.



To open Code Builder:

1. Click the **Code Builder** button  on the Standard toolbar.

Code Builder provides tools for writing, compiling, and debugging your Origin C functions. Once an Origin C function is compiled, the function becomes accessible from Origin.


 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

To learn more about programming in Origin, select **Help:Programming** and review the sample Origin projects located in the \Samples\Programming folder.

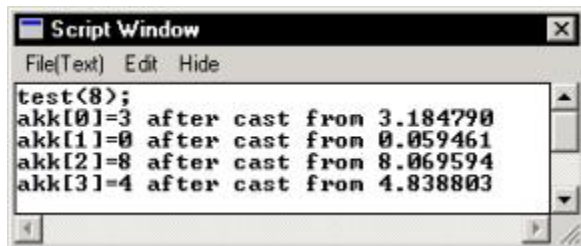
Script Window


The Script Window is useful for:

- simple calculations.
- math on and between datasets.
- executing LabTalk commands.
- getting or setting the value of a variable.

To open the Script Window, click the **Script Window** button  on the Standard toolbar. Note that when you save an Origin project, the Script Window contents are not saved with the project.

The Script Window



 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

To learn more about programming in Origin, select **Help:Programming** and review the sample Origin projects located in the \Samples\Programming folder.

Available Page Viewing Modes: Speed vs. Accuracy

How Origin Generates Screen Images

Depending on the selected view mode, Origin uses either the **screen driver** or the **printer driver** to generate the screen image. When Origin uses the screen driver to draw the screen, the page layout information is interpreted by the screen driver. The screen driver has a resolution which is generally lower than the printer driver resolution. Thus, when Origin uses the printer driver for the page layout information, what you see on screen will be closer to what you will see in the printed copy.

The view mode is set individually for each graph window and does not affect the quality of the printed output. Printed output always shows the high quality, WYSIWYG Print View image.

By the same token, since some of Origin's view modes *are not WYSIWYG*, you should not attempt to use anything but Print View to make final adjustments before printing or exporting your graph.

Full Screen

Full screen view mode expands the page in the active graph window to fill the entire screen. *This is a display-only view mode.* You cannot edit a graph in Full Screen mode. Toolbar buttons are not visible in Full Screen view mode.

To change the active window to Full Screen view mode, select **View:Full Screen**. To exit Full Screen view mode, click once with the mouse.

Draft View

Draft View has the fastest screen update of the four view modes. In Draft View, the page is automatically resized to fill the graph window. This is a convenient mode to use when you are primarily interested in looking at on-screen data.

To display the active graph window in the Draft View mode, do one of the following:

1. Select **View:Draft View**.

or

1. Select **Format:Page** to open the page's Plot Details dialog box.
2. Select the **Miscellaneous** tab and select **Draft View** from the **View Mode** drop-down list.

Page rotation is *disabled* in Draft View. Additionally, text rotation and text formatting (e.g. superscript, subscript, Greek symbols, and text styles and fonts) are not visible in Draft View. All text *displays in the system font only*. To view text rotation and formatting, switch to Page View or Print View.

Window View

Window View expands the page to fill up the entire graph window. Labels, buttons, or other objects in a graph window that reside in the gray area off the page are *not* visible in Window View mode.

To display the active graph window in the Window View mode, do one of the following:

1. Select **View:Window View**.

or

1. Select **Format:Page** to open the page's **Plot Details** dialog box.
2. Select the **Miscellaneous** tab.
3. Select **Window View** from the **View Mode** drop-down list.

Page View

Page View provides faster screen updating than Print View, but does not guarantee exact text placement on the screen unless you are using typeface scaling software (such as Adobe Type Manager). Page layout information is received from the screen driver; this provides for faster screen redraw. If Print View mode seems too slow to you, use Page View mode until your application is ready for printing or copying to another application. Change to Print View mode to check object placement before exporting, copying, or printing.

To display the active graph window in the Page View mode, do one of the following:

1. Select **View:Page View**.

or

1. Select **Format:Page** to open the page's **Plot Details** dialog box.
2. Select the **Miscellaneous** tab.
3. Select **Page View** from the **View Mode** drop-down list.

Print View

Print View is the **WYSIWYG** (What You See is What You Get) view mode. Font information is received directly from the printer driver, so that Print View displays a page that, in most cases, is exactly the page that is produced by your hard copy device. On-screen image quality may suffer slightly, as the printer driver fonts must be scaled to fit their positions on the page (this will not harm the appearance of true vector fonts).

Print View may be slow on some systems. If you find that window redraw times are excessive, consider using Print View mode only to preview your work prior to printing.

To display the active graph window in the Print View mode, do one of the following:

1. Select **View:Print View**.

or

1. Right-click in the graph window but outside the page and select **Print View** from the shortcut menu.

or

1. Select **Format:Page** to open the page's **Plot Details** dialog box.
2. Select the **Miscellaneous** tab.
3. Select **Print View** from the **View Mode** drop-down list.

The Origin Project


Opening an Origin Project File

To start a fresh Origin project file:

1. Click the **New Project** button  on the Standard toolbar.

If a project is already open, you are prompted to save the contents of the current session.

To open a saved Origin project file:

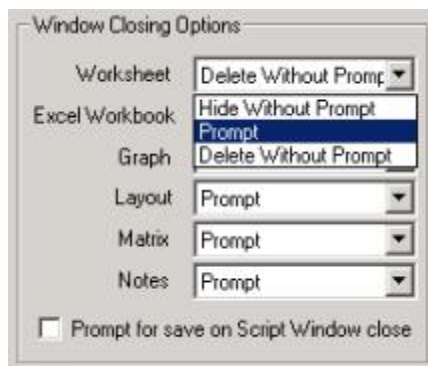
1. From the menu, choose **File: Open** or click .
2. In the **Open** dialog box, set **Files of Type** to **Project(*.OPJ)**.
3. Choose **File Name** and click **Open**.

Deleting a Window

To delete a window from the project, click the X button in the upper-right corner of the window. Origin then asks you if you want to hide or delete the window.

To prevent this verification prompt from displaying, select **Tools:Options** to open the Options dialog box. Then select the Open/Close tab. In the Window Closing Options group, select how you want Origin to respond when you click a particular window type's close button.

Setting the Close Option for a Window Type



Saving Child Windows from a Project File

You can save several types of Origin child windows externally from an Origin project file. These OGW, OGG, OGM and TXT files have numerous possible applications:

- Create a compact, editable file, that contains only supporting data. Subsequently, (1) insert this file into another Origin project file, (2) convert the file to a graphic file type (EPS, PDF, JPG, BMP, etc.), or (3) use it to create a custom template file.
- Graph, (OGG files) contain both the data plot and the supporting worksheet data. If you and another Origin user are working jointly on a manuscript, you could insert the OGG file into a Word document and both graph and supporting data would be mutually available for editing by you or your colleague.
- Text files can be used to save such things as fitting function formulae, statistical results or analysis procedures for later incorporation into more formal documents.

Window Type	File Extension
Worksheets	OGW
Graphs	OGG
Matrix	OGM
Notes	TXT

To save an Origin child window independently of the Origin project file:

1. Click on the child window to activate it.
2. From the menu, select **File: Save Window As...**
3. Choose a **Save In** folder, a **File Name**, and click **Save**.

Though not an Origin file type, you can also save Excel workbook files externally from your Origin Project file. For more information, see *Saving a Workbook Separately from the Project* on page 444.


Opening a Window from a File

If you have a window in one project that you want to include in the current project, you can append the projects. However, this action will add *all* windows from the appended project to the current project.

To add a single child window from one Origin project to a second Origin project, you must:


1. Save the child window to a file (To learn how to do this, see *Saving Child Windows from a Project File* on page 32).
2. Open the saved window in the second project file.

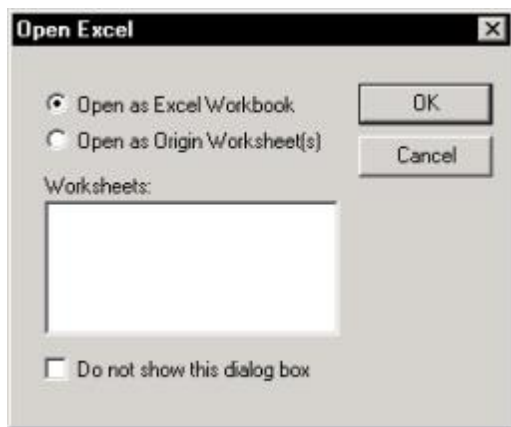
To open a worksheet, graph, matrix, or notes window that was saved to a file:

1. Click the **Open** button  on the Standard toolbar. This opens the **Open** dialog box.
2. From the **Files of Type** drop-down list, select:
 - ⇒ 'Worksheets (*.OGW)' to open a worksheet window.
 - ⇒ 'Graphs (*.OGG)' to open a graph or function graph window.
 - ⇒ 'Matrix (*.OGM)' to open a matrix window.
 - ⇒ 'Text (*.TXT)' to open a notes window.

When you open a worksheet, graph, matrix, or notes window file in a project, then *save* the project, the window becomes part of the current project.

To open an Excel workbook file:

1. Click the **Open Excel** button  on the Standard toolbar.
2. Select your Excel file. A dialog box opens asking if you want to **Open as Excel Workbook** or **Open as Origin Worksheet(s)**.



If you open the workbook as a workbook, you can use Excel's spreadsheet tools to process your data, while within the Origin workspace. You also have access to Origin's plotting and analysis tools. When you are ready to save your project, you can save the project with a link to your source workbook, and update the link, or you can save the workbook as part of your Origin project. When you update the link to a (linked) workbook, the updated workbook is available for other applications or other users.

If you open the workbook as one or more Origin worksheets, you have no access to Excel's spreadsheet tools in Origin. Furthermore, the data no longer has a connection to the source workbook. Thus, the changes you make to the data are lost to the original workbook.

Opening More than One Project

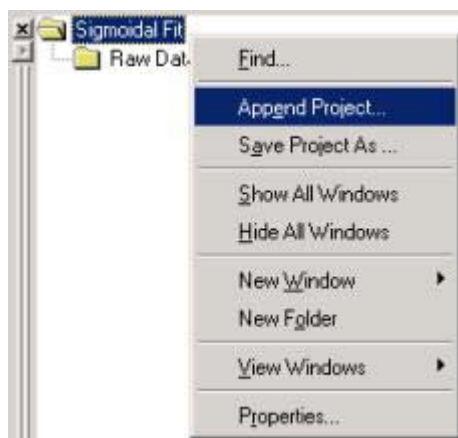
If you need to open multiple Origin projects, you have two options:

- You can run multiple instances of Origin, opening a single project in each instance.
- You can append an OPJ file to the open project file (see *Appending Projects*, below).

Appending Projects

The contents of a project can be added to the currently opened project by selecting **File:Append** or by right-clicking on a Project Explorer folder and selecting **Append Project** from the shortcut menu.

Appending Projects



After you select the project to append, Origin displays a Reminder Message asking if you want to append the contents of the new project into a new Project Explorer folder or into the current folder.

If duplicate window names exist between projects, Origin automatically changes the name of the appended window by adding an "A" to the window name.

For example:

In the following figure, a project containing a **Data1** worksheet is appended to a project that already contains a Data1 worksheet. Origin handles this by renaming the appended window **ADa1**.



Controlling the Default Window Type when You Open a New Project

Origin allows you to control the type of window that displays when you open a new project. This includes opening a new project from the **File:New** menu command, the New Project button on the Standard toolbar, and the new project that opens when you start Origin.

By default, Origin displays a worksheet window when you open a new project. To display either an Excel workbook window, graph window, matrix window, or no window at all, or to display a worksheet *and* a graph window, do the following:

1. Select **Tools:Options** when any window other than an Excel workbook window is active. If an Excel workbook window is active, select **Window:Origin Options**.
2. Select the **Open/Close** tab.
3. Make a selection from the **Start New Project** drop-down list. To display both a worksheet and graph window when you open a new project, select ORIGIN.OPJ from the drop-down list.

Deleting a Worksheet from a Project

When you delete a worksheet, you delete the worksheet window from the project, as well as all the data contained in the worksheet. Any other visual representations of that data are also deleted from the project. Thus, any data plots based on the deleted worksheet data are deleted from the respective graph windows.

To delete a worksheet from the project, perform one of the following operations:

- Click the Close Window button in the upper-right corner of the worksheet.
- Right-click on the worksheet window icon in Project Explorer and select **Delete Window** from the shortcut menu.
- Click on the worksheet window icon in Project Explorer and then press DELETE.

Because of the potential for unexpected loss of data, Origin opens a Deletion Confirmation box.

Note: Hiding a worksheet instead of deleting it allows you to visually remove the worksheet from the workspace, but maintain the window and data in the project. If you hide the worksheet, you can re-activate its view in the Project Explorer.

Creating an Automatic Backup of the Project File


To automatically create a backup of your Origin project file:

1. Give your Origin project a name (i.e. save the project file).
2. Enable automatic backup.
 1. From the Origin menu, choose **Tools: Options**.
 2. Click the **Open/Close** tab.
 3. Select **Backup Project Before Saving**.

Subsequently, when you save your project file, Origin renames your previously-saved file **BACKUP.OPJ** and saves the updated file with the Origin project file name.




Recovering the contents of a damaged Origin project file:

If you cannot open your Origin project file, you may be able to recover the contents of the project file, minus whatever changes were made to the project file during the time that it was last open. To do this:

1. Run Origin.
2. Choose **File: Open** or click .
3. Browse to the **User Files** folder.
4. Choose BACKUP.OPJ and click **Open**.

Saving an Origin Project File

To save an Origin project file:

1. From the menu, choose **File:Save, File:Save As...,** or click **Save** .
 - ⇒ If you have previously saved your work to an Origin project file, **File:Save Project** or **Save**  saves your project file, *without* prompting, to the file of the same name.
 - ⇒ If you have *not* previously saved your work to an Origin project file, **Save Project** or **Save**  opens the **Save As** dialog box.
 - ⇒ Choosing **Save Project As...** opens the **Save As** dialog box.

If the **Save As...** dialog box opens...

2. Set **Files of Type** to **Project(*.OPJ)**.
3. Choose **File Name** and click **Save**.

What is saved with the Origin Project File?

- all child windows on your screen.
- all child windows in other Project Explorer folders.
- datasets that make up the information in the child windows.
- the contents of the Results Log.
- internally saved Excel workbook files.

What is *not* saved with the Origin Project File?

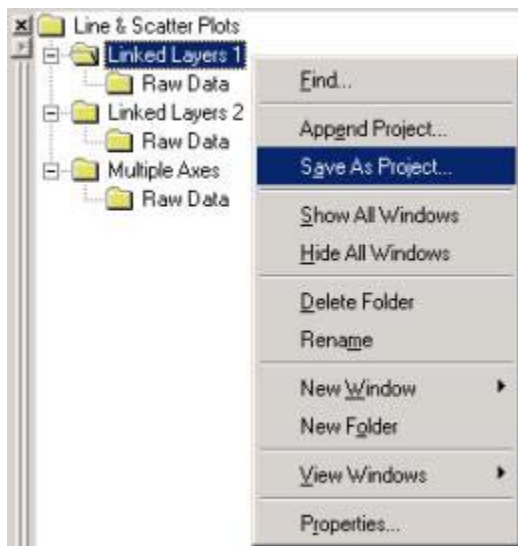
- Any deleted child windows.
- The contents of the Script window.
- Externally saved Excel workbook files.

Saving Part of a Project File

If you used Project Explorer to create a folder structure within your Origin project, you can save a folder and its subfolders to a new project file. To do this:

1. Right-click on the Project Explorer folder that you want to save as a project file.
2. Select **Save As Project** from the shortcut menu.

Saving a Project Explorer Folder to an Origin Project File



In this example, the **Linked Layers 1** folder and its **Raw Data** subfolder, all child windows in these folders, plus Results Log output specific to contained child windows, are saved to a new project file.

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The Worksheet

Arranging the Worksheet

The format of your worksheet may be altered as needed. Basic format options include:

- adding columns
- inserting columns
- deleting columns
- inserting rows
- deleting rows
- moving columns
- changing column width
- changing the row heading width
- transposing columns and rows
- other properties that affect the appearance of the worksheet such as text color, heading display options, grid display, etc.

Adding Columns

To append columns to the worksheet, do one of the following:

1. Select **Column:Add New Columns** (adds *n* columns).

or

1. Click the **Add New Columns**  button on the Standard toolbar (adds *1* column).

or

1. Right-click inside the worksheet window, to the right of the worksheet grid.
2. Select **Add New Column** from the shortcut menu (adds *1* column).

Columns are added as Y column(s), to the right of the last worksheet column. Each new column is named alphabetically (A, B, C, ... X, Y, Z, AA, BB, CC, ...), starting with the first letter that is not already used as a worksheet column name.

Inserting Columns

To add a single column to a specific location in the worksheet:

1. Highlight the column located to the immediate *right* of the desired insertion point.
2. From the menu, select **Edit:Insert** *or* right-click and select **Insert** from the shortcut menu.

The new column is inserted to the immediate left of the highlighted column, and is designated as a Y column, regardless of the designation of the highlighted column. Each new column is named alphabetically, starting with the first letter that is not already used as a column name in the worksheet.

To insert n columns in a specific location in the worksheet:

1. Repeat the above procedure n times.

or

1. Highlight n columns to the immediate right of the column insertion point.
2. Select **Edit:Insert** or right-click and select **Insert** from the shortcut menu.

Deleting Columns

To delete one or more columns from the worksheet:

1. Highlight column(s) to be deleted.
2. From the menu, select **Edit:Delete** or right-click and select **Delete**.

Note that when you delete columns (data sets) from the worksheet, *any other visual representation of the data sets will also be deleted from the project*. Thus, if you delete a column of data that also displays as a data plot in a graph window, the data plot is deleted from the graph window.

Note: To clear the column values but retain the columns, select **Edit:Clear**.

Inserting Rows

To insert a single row in a specific location in the worksheet:

1. Highlight the row that is directly *below* your desired insertion point.
2. From the menu, select **Edit:Insert** or right-click and select **Insert** from the shortcut menu.

The new row is inserted above the highlighted row.

To insert n rows in a specific location in the worksheet:

1. Repeat the above procedure n times.

or

1. Highlight n rows to the beneath the row insertion point.
2. Select **Edit:Insert** or right-click and select **Insert** from the shortcut menu.

Deleting Rows

To delete one or more rows from the worksheet:

1. Highlight the row(s).
2. From the menu, select **Edit:Delete** or right-click and select **Delete**.

After deleting the selected rows, the rows below the selection move up in the worksheet.

Note: To clear the cell contents but retain the row(s), select **Edit:Clear** instead of **Edit:Delete**.



Moving Columns

To move a column one position to the right:

1. Highlight the column.

2. Click the **Move Left**  or **Move Right**  buttons on the Column toolbar.

To move a column to the first or last position in the worksheet:

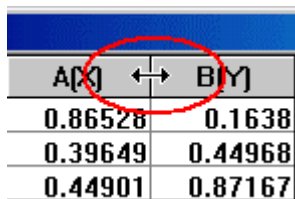
1. Highlight the column.
2. From the menu, choose **Column:Move to Last** or **Column:Move to First** or click the **Move to Last**  or **Move to First**  buttons on the Column toolbar.

Note: Using **Cut** and **Paste** will only move the *data*, not the column or column attributes.

Changing the Column Width

To change the width of a column:

1. De-select the column (if it is currently highlighted).
2. Point to the space between the column headings.
3. When the pointer becomes a double-headed arrow, drag the edge of the column heading.



A[X]	B[Y]
0.86528	0.1638
0.39649	0.44968
0.44901	0.87167

or

1. Double-click on the column to open the **Worksheet Column Format** dialog box.
2. Enter your value in the **Column Width** text box. This text box value is in units of characters.

See, *Reference: The Worksheet Column Format Dialog Box* on page 50.

Changing the Row Heading Width

To change the width of the row headings:

1. Double-click inside the worksheet window but to the right of the worksheet grid. This opens the **Worksheet Display Control** dialog box.
2. Type the desired value in the **Row Heading Width** text box (in the **Worksheet Measurement** group). The text box value is in units of 1/10 of the text height.

Transposing the Columns and Rows

To transpose the columns and rows in the active worksheet, select **Edit:Transpose**. This menu command exchanges the worksheet columns with rows, and the rows with columns.

- Prior to transposing, if the worksheet contains more row values than columns, Origin adds the necessary columns to the worksheet during the transpose process. Origin names these added columns alphabetically, starting with the first letter that is not already used as a column name in the worksheet.
- Prior to transposing, if the worksheet contains more columns than row values, Origin maintains the extra columns in the worksheet. This default behavior can be altered by selecting a new option from

the Delete Empty Columns After Worksheet Transpose drop-down list on the Miscellaneous tab of the Options dialog box (**Tools:Options**).

Note: To transpose the columns and rows in your worksheet, each of the columns in the worksheet must be of the same "display type." For example, each of the columns must be set to "Text and Numeric" type, or "Numeric" type. The column display type is set from the Display drop-down list in each column's Worksheet Column Format dialog box. Double-click on a column heading to open this dialog box. In the default Origin worksheet, each column is set to the "Text and Numeric" display type.

Aligning Objects with the Page Grid

The Tools toolbar (**View:Toolbars**) provides a series of tools to add text labels and other labeling objects to Origin's windows. To aid in the placement of these objects on the page of a worksheet window, enable the display of the page grid by selecting **View:Show Grid**. A check mark appears next to this menu command when the grid is enabled. To ensure that objects that are placed on the worksheet page align with the grid when the object is moved, select **Format:Snap to Grid**. A check mark appears next to this menu command when Snap to Grid is enabled.

The Worksheet Display Control Dialog Box

Use the **Worksheet Display Control** dialog box to customize column and row headings, worksheet grids and cell text.

To open the Worksheet Display Control dialog box, do one of the following:

1. Double-click inside the worksheet window but to the right of the worksheet grid.

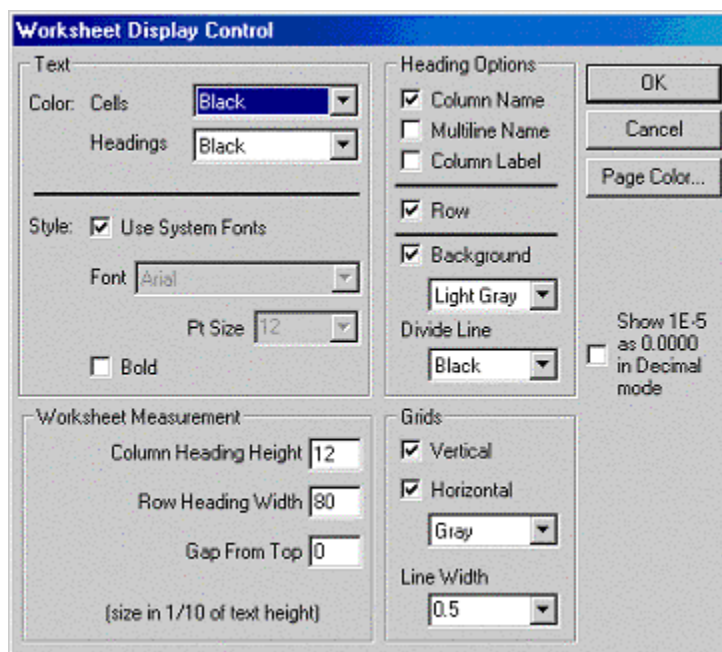
or

1. Select **Format:Worksheet** when the worksheet is active.

or

1. Right-click inside the worksheet window but to the right of the worksheet grid.
2. Select **Properties** from the shortcut menu.

Worksheet Display Control Dialog Box Controls

The Text Group

Set **Color** for worksheet **Cells** and **Headings**.

Select **Use System Fonts** to use the Windows system font for the worksheet cells and headings. To use a different font, clear this check box and select the alternate font from the **Font** drop-down list. Select **Pt Size**, and (optionally) **Bold** (for both cells and headings).

The Heading Options Group

Column headings can contain column names and labels. Select or clear the **Column Name** and/or **Column Label** check boxes to show or hide names and labels. Column names and labels are assigned in the column's respective Worksheet Column Format dialog box.

Select **Multiline Name** to display the column name on more than one line. This applies *only if* a period (.) is inserted *before* the text to appear on the next line in the **Column Name** text box of the Worksheet Column Format dialog box.

Note: To view the second line of the column name and the column label in the column label field, you may need to increase the column heading height in the **Worksheet Measurement** group.

Select **Row** to enable the display of row numbers.

To customize the background and divider line color for column and row headings, select **Background** and choose a color (this is distinct from the worksheet page color).

The Worksheet Measurement Group

Set **Column Heading Height**, **Row Heading Width**, and **Gap from Top** in *tenths* of text height (e.g. a value of 12 = 12/10ths, or 120%, of text height). When including a column label, it is necessary to increase the column heading height (Origin will prompt to automatically increase the Column Heading Height value).

Note: The **Row Heading Width** text box does not affect column width(s).

Select **Gap From Top** to add space between the worksheet column headings and the worksheet title bar. Space can be added to accommodate text labels or button objects above the worksheet grid (but within the worksheet window).

The Grids Group

Controls for the worksheet grid display. Line width is in point size.

The Show 1E-5 as 0.0000 in Decimal Mode Check Box

When selected, this overrides the **Scientific Notation Lower Threshold** setting on the Numeric Format tab of the Options dialog box (**Tools:Options**) for columns set to **Display = Decimal** with **Numeric Display = Set Decimal Digits**. Such columns will always display numbers with the specified number of decimal digits, rounding and padding with 0's as needed. For example...

- 0.00001 (1E-5) would display as 0.0000
- 0.00005 would display as 0.0001
- 0.1 would display as 0.1000

...even if the **Scientific Notation Lower Threshold** setting was -3 (installation time default).

The Page Color Button

Click **Page Color** to open the Page Color dialog box. Sets the background color for the active worksheet.

Also, see *Reference: The Worksheet Column Format Dialog Box* on page 50.

Navigating the Worksheet

Selecting Cells⁷

To select a range of cells in the worksheet, click-and-drag to select the cells.

Selecting Contiguous Columns

To select adjacent columns in the worksheet, do one of the following:

1. Click to select *the first column heading* in the desired range and then *drag* the pointer to the *last* column in the desired range. Release the mouse button to select the columns.

or

1. Click to select the first column heading in the desired range.
2. Scroll the worksheet (using the scroll bars at the bottom of the worksheet, as needed) to display the last column in the desired range.
3. Hold down the SHIFT key and click on this last column heading.

Selecting Noncontiguous Columns

To select noncontiguous columns in the worksheet:

1. Click to select the first column heading.

2. Hold down the CTRL key while clicking on additional column headings.

Selecting the Entire Worksheet

To select all the columns in the worksheet, do one of the following:

1. Point to the blank space in the upper-left corner of the worksheet. When the pointer becomes a downward pointing arrow, click once to select all columns (datasets) in the worksheet.

or

1. Click to select the first column heading, then drag the pointer across all remaining column headings in the worksheet.

or

1. Click to select the first column heading, scroll the worksheet until the last column is visible.
2. Press the SHIFT key and click on the last column heading.

Selecting Rows

To select a row range, perform one of the following operations:

- Click to select the first row heading in the desired range and then drag to the last row in the desired range. Release the mouse button to select the rows.
- Click to select the first row heading in the desired range, scroll the worksheet to display the last row in the desired range, and then hold down the SHIFT key and click on this last row heading.

Scrolling to a Specified Row Number

To view a specific row in the worksheet:

1. From the Origin menu, select **View:Go to Row**.

or

1. Right-click inside the worksheet window (but to the right of the worksheet grid) and select **Go to Row** from the shortcut menu.

then

2. Type the row number in the **Go to Row** dialog box and click **OK**.

Worksheet Columns (Data Sets)

Understanding Column Associations in the Worksheet

Each worksheet column is tagged with a **Plot Designation** that instructs Origin as to how to treat the data when plotting or performing analyses. Plot Designations are **X**, **Y**, **Z**, **X Error** (bar), **Y Error** (bar), **Label**, or **Disregard**. These Plot Designations appear surrounded by parentheses in the column heading.

A[X]	B[Y]	C[YErr]	D[L]
------	------	---------	------

How Origin Uses Column Plot Designations

- When a worksheet contains **one** X column, Origin creates an association between the X column and all the Y columns in the worksheet. When any Y column is selected for plotting, Origin uses the associated X column values to create the data plot, even if the X values are not selected for plotting.
- When a worksheet contains **multiple** X columns, Origin creates multiple associations. Origin designates the leftmost X column as X1, and all Y columns to the right of the X1 column - but to the left of the next X column - are designated Y1. The second X column is designated X2, and all Y columns to the right of the X2 column - but to the left of the next X column - are designated Y2, etc. When any Y1 column is selected for plotting, Origin uses the associated X1 column values to create the data plot, even if the X1 values are not selected for plotting. Similarly, when any Y2 column is selected for plotting, Origin uses the associated X2 column values to create the data plot.

Designating a Column as X, Y, Z, Error, Label, or Disregard

Each worksheet column has one of seven column (**Plot**) **Designations**: **X**, **Y**, **Z**, **X Error** (bar), **Y Error** (bar), **Label**, or **Disregard**. The Plot Designation determines how selected data will plot - as X values, Y values, Z values, data labels (text annotations associated with specific XY coordinates), error bars, or not at all (disregarded).

To change the designation of a *single* column, do one of the following:

- Right-click on the column heading and select **Set As:Designation**.
- or
- Select the column and then select **Column:Set as Designation**.
- or
- Select the column and then click the appropriate button on the Column toolbar.
- or
- Double-click on the column heading to open the **Worksheet Column Format** dialog box. Select the desired column designation from the **Plot Designation** drop-down list.
- or
- Select the column and then select **Format:Column**. This menu command opens the **Worksheet Column Format** dialog box. Select the desired column designation from the **Plot Designation** drop-down list.

To change the designation of *multiple* columns, do this:

- Select worksheet columns.
- Right-click on the selected columns and choose **Set As**.
- Choose from **XXY**, **XYXY**, **XYXXYY**, **XYXXYY**, etc.

Possible Column Designations

Designation	Description
X, Y, Z:	In a worksheet with one designated X column , the X column provides X values for all Y and Z columns in the worksheet, independent of column locations in the worksheet. For a worksheet with more than one designated X column , each X column provides X values for all Y and Z columns that are located to the right of the X column (but to the left of an additional X column). In the case of nonadjacent column selection, the selected X column provides X values for the selected Y and the selected Z columns. If an X column isn't included in the selection, Origin finds the first X column to the left of

Designation	Description
X, Y, Z (cont'd):	the selected Y column or Z column. If none exists, Origin looks to the right of the selected Y column (Origin will not look to the right for an X column associated with a Z column).
X Error	In a worksheet with one designated X column , values in an X error column set the size of the X error, independent of column locations in the worksheet. For a worksheet with more than one designated X column , values in an X error column set the size of the X error for the first X column to the left of the X error column. If none exists, Origin looks to the right of the selected X error column. In the case of nonadjacent column selection, the selected X error column provides the X error values for the selected X column. If more than one X column is selected, Origin looks to the left for a selected X column and if none exists, then to the right. If an X column isn't included in the selection, Origin finds the first X column to the left of the selected X error column. If none exists, Origin looks to the right of the selected X error column.
Y Error	Values in the Y error column set the size of the Y error for the first Y column to the left of the Y error column. In the case of nonadjacent column selection, the selected Y error column provides the Y error values for the selected Y column located closest to the left of the Y error column.
Label	Text or numeric values in a label column plot as data labels for the associated Y column values immediately to the left of the label column. In the case of nonadjacent column selection, the selected label column provides data labels for the selected Y column. If more than one Y column is selected, Origin finds the selected column located closest to the left of the label column.
Disregard	Disregarded columns are not plotted, even if selected in the worksheet.

Setting up a Worksheet with Multiple X Columns

To set up a worksheet with multiple X columns, do one of the following:

1. Select the entire worksheet, or the desired range of columns, and then right-click in the selection range and select **Set As:XXX, XY XY, XYY XYY, or XXXX XXXX**.

or

1. Select the desired column or columns (hold down the CTRL key for nonadjacent column selection) and then select **Column:Set As X** or right-click in the selection and select **Set As:X**.

When a worksheet has multiple X columns, Origin creates the following association between X and Y columns:

All Y columns to the right of an **X** column are automatically associated with that X column. Origin illustrates the association by designating the first X column as **X1**, with the associated Y columns designated **Y1**. The second X column is designated **X2**, and its corresponding Y values are **Y2**.

When any Y1 column is selected for plotting, it will automatically plot against the column designated as X1. Similarly, columns designated as Y2 will automatically plot against the column designated as X2.

If two or more adjacent columns are designated as X, then Origin will set the designation as follows:

A(X1) B(Y1) C(Y1) D(X2) E(X3) F(Y3) G(Y3)

In this example, if one or both of the **Y3** columns are selected for plotting, they will automatically plot against the column designated as **X3**. No columns will automatically plot against the column designated as **X2**.

What if the Worksheet has No X Column?

When you create a graph by highlighting the desired worksheet data and selecting **Plot:Graph Type** or **Plot:Template Library**, and the worksheet has no X column(s), Origin uses the associated row number [*i*] as the X value for each data point.

Alternatively, incremental X values can be created for a worksheet that has no X column.

To assign X values from a column which is not designated as an X column in the worksheet, you must plot using the **Plot Setup** dialog box. This dialog box may also be used to define incremental X values for the plotting instance.

Setting up a Worksheet without X Columns

Worksheets can be created that contain *no* X columns. To set the worksheet up without an X column:

1. Select the column(s) currently designated as X.
2. Change the designation to Y (or other).

When you select one or more Y columns in a worksheet that has no X column and select **Plot:Graph Type**, **Plot:Template Library**, or click a button on one of the plotting toolbars, Origin plots the Y data against these default X values:

- the corresponding row number.
- or
- incremental X values of your choosing.

Creating Incremental X Values

The **Set Worksheet X** menu command provides a quick way to set worksheet X values that have a regular increment (for example, 0.5, 1.0, 1.5 ...). This menu command is not available if the worksheet already contains an X column.

To set incremental X values for a worksheet with no X column:

1. Select worksheet columns.
2. Select **Format:Set Worksheet X**. This menu command opens the For Selected Columns in *Worksheet* dialog box.
3. Set the **Initial X value** and the **Increment in X** for the active worksheet.

Displaying Default X Values

To display the default X values in the worksheet:

1. Select **View:Show X Column**.

This menu command is operative even if you did not create default X values using the **Format:Set Worksheet X** menu command. In this case, Origin uses an initial X value and increment of 1.

Note: The **View:Show X Column** menu command is not available if the worksheet already contains an X column.

Categorical Data Support

Origin supports plotting categorical data in *both X and Y columns*. Before plotting categorical data, you must set the column to data type = Categorical:

1. Select the column.
2. From the menu, choose **Column:Set as Categorical** (or right-click on the selected column and choose **Set as Categorical** from the shortcut menu).

When you plot a Categorical X column and one or more associated Y columns, Origin creates a graph with the X categories as X axis tick labels. These tick labels are organized alphabetically (categories starting with numeric values are first) and are evenly spaced across the X axis. The Y data are plotted at associated X tick values.

If your worksheet contains a Categorical Y column, then you can map this categorical data to your data plots, displaying categories of data using the same symbol shape, color, size, or other plot attribute.

For more information, see *Plotting Categorical Data* on page 141.

Naming Columns and Adding Labels

By default, Origin names columns alphabetically, starting with the leftmost column in the worksheet.

To name a column:

1. Double-click on the column to open the **Worksheet Column Format** dialog box.
2. Type the name in the **Column Name** text box.

The column name must be one word (although it can be displayed on multiple lines) and must begin with a letter or a number. The name is also restricted to 18 characters.

The **column name** does more than visually identify a worksheet column. The column name becomes part of the data set name that it contains. Origin names data sets using the following convention:

WorksheetName_ColumnName

For example, if the worksheet name is Data1 and the column name is A, then the data set in column A is named:

Data1_A

Origin uses this data set naming convention in various locations, including the graph window's **Layer n** dialog box. This notation is used when writing scripts using LabTalk.

The **column label** provides additional information about the data set. If a column label exists, it displays in the default legend for most of the graph templates (instead of the column or data set name).

To add a column label:

1. Double-click on the column to open the **Worksheet Column Format** dialog box.
2. Type the label in the **Column Label** text box.
3. Click **OK**.

You are prompted to automatically display the column label (see, The Heading Options group of the Worksheet Display Control dialog box).

Max number of characters is 63 in a one line label; special characters are permissible.

Note: When importing ASCII data into a worksheet, Origin automatically creates column labels using the first and second line of header text, if it exists.

Data Format and Display Characteristics

Reference: The Worksheet Column Format Dialog Box

Use the **Worksheet Column Format** dialog box to name or add labels to the column, to set the plot designation (X, Y, Z, etc.), data format and numeric display, and column width.

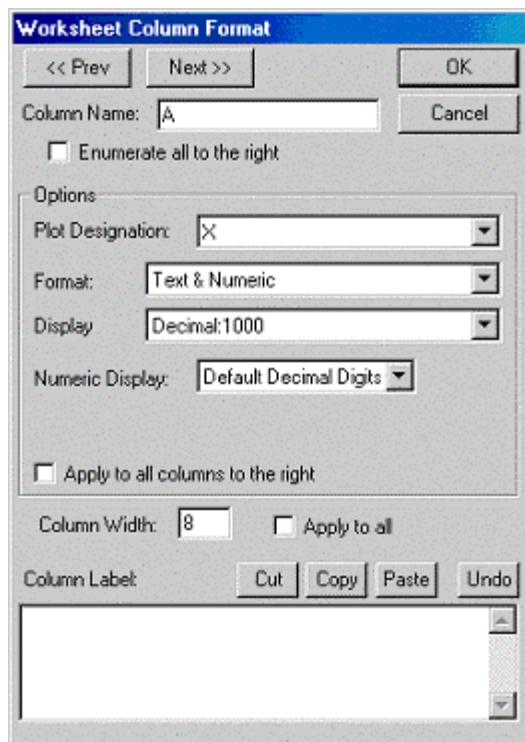
To open the Worksheet Column Format dialog box:

1. Double-click on the worksheet column heading.

or

1. From the menu, select **Format:Column**.

Worksheet Column Format Dialog Box Controls



The Prev and Next Buttons

Moves the column selection one column to the left or right.

The Column Name Text Box

The column name must be:

- one word (although it can be displayed on multiple lines)

To display the name on multiple lines:

1. Insert a period (.) where you want the line to break.
 2. Select the **Multiline Name** check box in the **Worksheet Display Control** dialog box.
- must begin with a letter or a number. The name is also
 - restricted to 18 characters.

The Enumerate All to the Right Check Box

Select this check box to use the name in the current column as the base name for all columns to the right, and then number each of these columns, starting with the current column. For example, if the current column is named "test" and this check box is selected, then the current column is renamed "test1", the first column to the right is renamed "test2", etc.

The Options Group

The Plot Designation Drop Down List

Determines how the selected data will plot - as X values, Y values, Z values, data labels (text annotations associated with specific XY coordinates), error bars, or not at all (disregarded). Select the desired designation from the **Plot Designation** drop-down list. After clicking **OK**, the column heading displays the new designation.

The Format Drop Down List

Option	Description
Numeric	Accepts only numeric values.
Text	Accepts any alphanumeric characters. Values in a text column are treated as text, and can not be used in calculations.
Time	Accepts only 24-hour clock values. Enter hours:minutes:seconds:fractions-of-second, separated by colons.
Date	Accepts only calendar-accurate date values. Enter numeric or text values separated by a space, slash, or hyphen. For example, 1/18/99 or Mon Jan 18 1999 are both valid entries. Origin will only display <i>possible</i> dates. For example, 2/31/99 and Thursday 1/18/99 are not actual calendar dates, and thus are invalid entries. Additionally, if a date entry is incomplete, Origin assumes the current date for the missing information. For example, Origin will assume 1/18 is 1/18/99, if the current year is 1999.
Month	Accepts only month values. You can enter months as numeric values (1 - 12) or text values. The latter can be abbreviated to one character, as long as the character represents a unique month. For example, N for November, but Jun for June.
Day of week	Accepts only days of the week. Enter numerically(0 - 6) or as text values (M or Mon, T or Tue, etc.).
Text & Numeric	This is the default data type for all column designations except for "label." Accepts any alphanumeric characters. However, the text values are treated as missing values for all worksheet operations (such as plotting data points and performing mathematical operations), except where cell values are retrieved as text (such as plotting a data label).

Note 1: The default column type in post-Origin 6.0 worksheets is **Text & Numeric**, whereas the default column type in previous versions was **Numeric** with an internal data type of Double(8).

Note 2: If you are planning on sharing your Origin project with a colleague who has **Origin 4.1**, you should not use the Text & Numeric column type. Doing so could cause a loss in data when the project is opened in Origin 4.1. To ensure that all columns in all new worksheets are Numeric type instead of Text & Numeric, select the Use Numeric as Preferred Column Type check box on the Miscellaneous tab of the Options dialog box (**Tools:Options**).

The **Display** Drop Down List

Format = Numeric or Text & Numeric

Option	Description																																	
Decimal:1000	(1, 1000, 1E6, 1E9) Note: The threshold for conversion to scientific notation is controlled on the Numeric Format tab of the Options dialog box (Tools:Options).																																	
Scientific:1E3	(1E0, 1E3, 1E6, 1E9)																																	
Engineering:1k*	(1.0, 1.0k, 1.0M, 1.0G) <u>Origin supports the following Engineering data suffixes:</u> <table><tr><th>suffix</th><th>equivalent</th><th>quantity</th></tr><tr><td>k</td><td>kilo</td><td>10^3</td></tr><tr><td>M</td><td>mega</td><td>10^6</td></tr><tr><td>G</td><td>giga</td><td>10^9</td></tr><tr><td>T</td><td>tera</td><td>10^12</td></tr><tr><td>P</td><td>peta</td><td>10^15</td></tr><tr><td>m</td><td>milli</td><td>10^-3</td></tr><tr><td>u</td><td>micro</td><td>10^-6</td></tr><tr><td>n</td><td>nano</td><td>10^-9</td></tr><tr><td>p</td><td>pico</td><td>10^-12</td></tr><tr><td>f</td><td>femto</td><td>10^-15</td></tr></table> <p>Note that "u" is Origin's universal notation for micron. The only exception is graph axes tick labels, which support "mu". Note also that Origin 7 does not support "E" and "a" as suffixes.</p>	suffix	equivalent	quantity	k	kilo	10^3	M	mega	10^6	G	giga	10^9	T	tera	10^12	P	peta	10^15	m	milli	10^-3	u	micro	10^-6	n	nano	10^-9	p	pico	10^-12	f	femto	10^-15
suffix	equivalent	quantity																																
k	kilo	10^3																																
M	mega	10^6																																
G	giga	10^9																																
T	tera	10^12																																
P	peta	10^15																																
m	milli	10^-3																																
u	micro	10^-6																																
n	nano	10^-9																																
p	pico	10^-12																																
f	femto	10^-15																																
Decimal:1,000	(1, 1,000, 1E6, 1E9) Note: The threshold for conversion to scientific notation is controlled on the Numeric Format tab of the Options dialog box (Tools:Options).																																	

*A LabTalk system variable (@EF) is provided to enter engineering notation in a non-engineering column. If you set @EF = 1, and then enter engineering notation in a non-engineering column, Origin will treat the entry as numeric. Otherwise (@EF = 0), Origin will treat the entry as text (default). To learn more about LabTalk system variables, see the Programming Help file (**Help:Programming**).

Format = Time

The Display drop-down list provides a display selection of hours, minutes, seconds, fractions-of-second, and an AM/PM indicator.

Format = Date

The Display drop-down list provides a display selection of date values. The entire date value - month, day, and year - is always preserved, but specific sections of the date can be displayed.

The first two date formats from the drop-down list display your Windows regional date setting (the first item is the short regional format and the second is the long regional format). You can customize these Windows regional settings and thus access the custom format in Origin.

Origin's date formats are listed below these regional formats.

The last two date formats in the drop-down list are Origin's available custom date formats. To customize these date formats, edit the Custom Dates Formats group on the Miscellaneous tab of the Options dialog box (**Tools:Options**).

Origin provides flexibility when entering date values into a worksheet cell. For example, to enter January 20, 1999, you could enter 1/20/99, 1.20.99, 1-20-99, 1,20,99, etc. You could also enter Wednesday, January 20, 1999 or January 20, 1999. Each entry is accepted and Origin displays the date based on the Display drop-down list selection.

Format = Month

Three month display formats are available: *J* abbreviates the month to a single letter, *Jan* abbreviates to three letters, and *January* displays the entire month.

Format = Day of Week

Three day of week display formats are available: *M* abbreviates the day to a single letter, *Mon* abbreviates to three letters, and *Monday* displays the entire word.

The Numeric Display Display Drop Down List (Text & Numeric and Numeric Formats only)

Option	Description
Default Decimal Digits	Display all digits in a worksheet cell as determined by the Number of Decimal Digits combination box value on the Numeric Format tab of the Options dialog box (Tools:Options).
Set Decimal Places =	The number of digits that display after the decimal place (overrides the Number of Decimal Digits setting on the Numeric Format tab of the Options dialog box). Type the decimal place value (<i>n</i>) in the associated text box. This value = the maximum number of digits displayed after the decimal point. If the field is blank, the default value is used (value = 5 for Double (8) internal data types).
Significant Digits =	The number of digits displayed. Type the value in the associated text box.

The Internal Data Drop Down List (Numeric Format only)

Double(8) allocates eight bytes of storage space to each value.

- supports missing values.
- only data type that will work with all math and fitting operations.

Float(4) allocates four bytes of storage space per value.

Integer(2) allocates two bytes of storage space per value.

Long(4) allocates four bytes of storage space per value. However, the value is stored as an integer.

Note: Set the internal data type *before* you enter the data. Otherwise, you risk losing some precision.

The Apply to All Columns to the Right Check Box

Apply the settings in the **Options** group to all columns to the right in the worksheet.

The Column Width Text Box

Enter the column width. The text box value is in units of characters.

The Column Label Text Box

If text is entered in the Column Label text box, it will be displayed in the graph legend instead of the column name. The maximum number of characters in a one line column label is 63. There are no restrictions on the characters entered. The Cut, Copy, Paste, and Undo buttons are available for editing the column label.

After you click OK to close the Worksheet Column Format dialog box, an Attention prompt asks if you want to display the column labels. If you click No, you can activate the display later by selecting **Format:Worksheet** and selecting the Column Label check box.

Numeric vs Text & Numeric

The **Text & Numeric** format uses approximately 20% more memory than type **Numeric Double(8)**. In most cases this difference will not cause problems.

To configure Origin to use, by default, Numeric Double(8) for all columns in new worksheets:

1. From the menu, select **Tools:Options**.
2. Click the **Miscellaneous** tab.
3. Select **Use Numeric as Preferred Column Type**.

If you need to save even more memory (upwards of an additional 50%), you can change columns to **Format = Numeric** with an **Internal Data** type of **Float(4)**. To learn more, see *Reference: The Worksheet Column Format Dialog Box* on page 50.

CAUTION: Use of internal data types less than Double(8) may cause problems with various math operations.

Format and Numeric Display

When the worksheet column is set to **Format = Numeric** type or **Text & Numeric** (in the **Worksheet Column Format** dialog box), the number of displayed digits is determined by a combination of these settings in the **Worksheet Column Format** dialog box:

- **Display.** Specify decimal, scientific, or engineering formats.

- **Numeric Display.** This is the number of decimal places or significant digits to display in the column (data set).

If not specified (i.e. Numeric Display is set to **Default Decimal Digits**), Origin uses...

- A global **Number of Decimal Digits** setting in the **Numeric Format tab** of the **Options** dialog box.

Note that the Numeric Display settings in the Worksheet Column Format dialog box *take precedence over* the global setting in the Options dialog box.

To set the number of default decimal digits (global except as specified in the next procedure):

1. From the menu, choose **Tools: Options**.
2. Click the **Numeric Format** tab.
3. Set the number of **Default Decimal Digits**.

To set the number of significant digits or decimal places for one or more datasets in a worksheet:

1. With the worksheet active, select **Format Column**, or double-click on the worksheet column heading. This opens the Worksheet Column Format dialog box.
2. Change **Numeric Display** from **Default Decimal Digits** to **Set Decimal Places =** or **Significant Digits =**, and enter a number in the text box to the right (max Decimal Places = 13; max Significant Digits = 16).
3. Optionally, select **Apply to All Columns to the Right**.

Decimal, Scientific, and Engineering Notation

Origin supports display of worksheet data in **Decimal:1000**, **Scientific:1E3**, **Engineering:1k**, and **Decimal:1,000** formats. Decimal:1000, Engineering:1k, or Decimal:1,000, Origin use additional controls for the **Upper Threshold Power** and the **Lower Threshold Power** for use of these formats.

By default, these control values are set to 6 and -3, respectively. This means:

- For values in the range of 1×10^{-3} to 1×10^6 , data will display using the format specified in the Format drop-down list in the Worksheet Column Format dialog box.
- For values that exceed either the lower or upper conversion thresholds (less than 1×10^{-3} or greater than 1×10^6), data will display in **scientific notation**, *regardless* of the setting in the Format drop-down list.

To change the default threshold power controls:

1. Select **Tools:Options**.
2. In the **Scientific Notation** group, set the **Upper Threshold Power** and **Lower Threshold Power**.

Displayed Cell Value vs Actual Cell Value

When you import or type your data into a worksheet, Origin uses the number of digits/decimal places settings to display the data in each cell. Note that this is merely a visual representation of the data set; the actual data values are stored, and when you perform calculations, it is the actual data values that are used, not the displayed values.

A Note on Dates and Times in Origin

Origin interprets dates based upon the Gregorian Calendar. Time is interpreted in hours:minutes:seconds. Origin supports the following date range:

- When entering **four digits** for the year, Origin supports a date range of:
1/1/0100 to 12/31/9999.
- When entering **two digits** for the year, Origin supports a date range of:
0 to 44 = 2000 to 2044
45 to 99 = 1945 to 1999

Origin's mathematical system for dates and time is based on Astronomical Julian Day Numbers. This defines -4712 January 1, 12 hours Greenwich Mean Time as zero. Origin uses a 12 hour offset in order to have 0 hours coincide with midnight. No assumptions are made about time zones or any time shifting scheme (such as Daylight Savings).

In this system, for example:

11 June 1998 at 21:23:01

has an Origin Julian Day Number of

2450975.890984.

Add **.5** (Origin's 12 hour offset) to get the true Julian Day Number of **2450976.390984.**

Dates and Times in the Worksheet

Origin's worksheet supports **Date** and **Time** as Format types and will display various specific date and time formats. **Month** and **Day of Week** are also supported.

Note that there is a difference between the date- and time-formatted text that displays in the worksheet column and the underlying numeric value that is used for plotting and calculation.

Dates and Times for Given Format and Display Settings:

Format is set to...	Display is set to...	Entering this...	Displays this...	Numeric Value
Date*	06/12/1998	6-12-98	06/12/1998	2450976
	Friday, June 12, 1998	6/12/98	Friday, June 12, 1998	2450976
	06/12/1998 hh:mm	6.12.98 12:30	06/12/1998 12:30	2450976.5208333
Time*	hh:mm	6	06:00	.25
	hh:mm pm	3 a	03:00 AM	0.1354167
Month**	January	Ja	January	1
	Jan	10	Oct	10

Day of Week**	Monday	Friday	Friday	5
	Mon	2	Tue	2

*internal numeric values are Julian Day Numbers.

**internal numeric values are ordinal numbers.

These internal numerical values become important when performing math operations with any of the Date/Time column types.

When you import an ASCII file, Origin may initially treat a column as **Text** when it should be treated as Date or Time values. By changing the Format, Origin will convert the data to a proper Date/Time format.

Note: When you enter a two digit value for the year, Origin uses an implied year range:

0 to 44 = 2000 to 2044

45 to 99 = 1945 to 1999

If you select a two digit year date display format from the Worksheet Column Format's Format drop-down list (for example, MM/DD/YY), and then enter a four digit year that is outside of this implied year range, *Origin will display all four digits in the year*.

As an example, if you select MM/DD/YY, and then type 3/4/2045 in a worksheet cell, Origin will display 3/4/2045. However, if you type 3/4/1945 in a worksheet cell, Origin will display 3/4/45. In the first case, the four digit year was outside of the implied range, so Origin displayed all four digits to avoid confusion. In the second case, the four digit year was within the implied range, so Origin displayed the two digit year.

Worksheets: Windows and Templates

Saving a Worksheet as a Template

Worksheets are created from templates. A worksheet template file (*.OTW) contains instructions for constructing the worksheet window. The template file determines such things as the number of columns, column designations, formulas associated with a column, and scripts associated with the worksheet.

To save the active worksheet as a template:

1. Select **File:Save Template As**. This menu command opens the **Save As** dialog box.
2. Specify a name (and folder) for the template. The OTW extension is automatically added.

To create a worksheet based on a specific (OTW) template:

1. Select **File:New**. This menu command opens the **New** dialog box.
2. Select **Worksheet** from the **Window Type** list box.
3. If necessary, use the browse button to the right of the **Path (Template group)** to locate the OTW file.
4. Select the worksheet template from the **Name** drop-down list.
5. (Optionally) Specify this as the default worksheet template by clicking **Set Default**.

Attributes Saved with a Worksheet Template

The worksheet attributes that can be saved to a template are controlled from the following dialog boxes:

- The **Worksheet Display Control** dialog box.

The **Worksheet Display Control** and associated **Page Color** dialog boxes provide customization of the color, style and size of font, and the colors and dimensions of various elements.

To open the Worksheet Display Control dialog box:

1. select **Format:Worksheet** when the worksheet is active.

To learn more, see *The Worksheet Display Control Dialog Box* on page 42.

- The **Page Color** dialog box.

The **Worksheet Display Control** and associated **Page Color** dialog boxes provide customization of the color, style and size of font, and the colors and dimensions of various elements.

To open the **Page Color** dialog box:

1. select **Format:Worksheet** when the worksheet is active.
2. Click the **Page Color** button in the **Worksheet Display Control** dialog box.

To learn more, see *The Worksheet Display Control Dialog Box* on page 42.

- The **Worksheet Column Format** dialog box.

The **Worksheet Column Format** dialog box sets the name, column type, format options, column width, and column label for the active column.

To open this dialog box:

1. Select **Format:Column** when a worksheet column is selected.

To learn more, see *The Worksheet Display Control Dialog Box* on page 42.

- The **Origin Import Filter (*.OIF)** file (optional).

When you use the **Import Wizard** to import data, you have the option of creating and saving an **Origin Import Filter** file (*.OIF) for later use with the same or similar files. The filter files can be saved to a worksheet template that you set up for importing your data files.

To learn more, see *Import Wizard* on page 88, and *Saving Import Wizard Filter Files* on page 105.

In addition, you may want to review *Origin's Drag-and-Drop Data File Support for Worksheets* on page 83.

- The **ASCII Import Options for Worksheet** dialog box.

The **ASCII Import Options for Worksheet**, **Data Import Options for Worksheet**, and **Import Verification** dialog boxes set the default import behavior for a worksheet.

To open these dialog boxes:

1. Select **File:Import:ASCII Options** or **File:Import:Other Options**.

To learn more, see Importing ASCII Files on page 73.

Also, see Import Wizard.

- The **Data Import Options for Worksheet** dialog box.

The **ASCII Import Options for Worksheet**, **Data Import Options for Worksheet**, and **Import Verification** dialog boxes set the default import behavior for a worksheet.

To open these dialog boxes:

1. Select **File:Import:ASCII Options** or **File:Import:Other Options**.

To learn more, see Importing ASCII Files on page 73.

Also, see Import Wizard.

- The **Import Verification** dialog box.

The **ASCII Import Options for Worksheet**, **Data Import Options for Worksheet**, and **Import Verification** dialog boxes set the default import behavior for a worksheet.

To open these dialog boxes:

1. Select **File:Import:ASCII Options** or **File:Import:Other Options**.

To learn more, see *Importing ASCII Files* on page 71.

Also, see *The Import Wizard* on page 86.

- The **ASCII Export Into** dialog box.

The ASCII Export Into dialog box sets the default export behavior for the worksheet, including controlling the export of column names and labels, and the data separator.

To open this dialog box:

1. Select **File:Export ASCII**.
2. Click **Save** (the Export ASCII dialog box).

Origin opens the **ASCII Export Into** dialog box.

To learn more, see *Exporting Worksheet Data* on page 621.

- The **Set Column Values** dialog box.

The equations in the **Set Column Values** dialog box are saved with the template.

To open this dialog box:

1. Select **Column:Set Column Values**.

To learn more, see *Using Functions to Set Column Values or Mathematically Transform Values* on page 67.

- The **Extract Worksheet Data** dialog box.

The equations in the **Extract Worksheet Data** dialog box, are saved with the template.

To open this dialog box:

1. Select **Analysis:Extract Worksheet Data**.

To learn more, see *Extracting Data from the Worksheet* on page 468.

- The **Worksheet Script** dialog box.

The script in the **Worksheet Script** dialog box is saved with the template.

To open this dialog box:

1. Select **Tools:Worksheet Script**.

To learn more, see *Associating LabTalk Scripts with Worksheets* and *The Worksheet Script Dialog Box* on page 111.

- The dialog boxes that control any annotations on the worksheet.

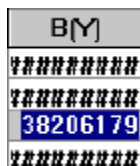
This would include...

- the **Text Control** dialog box.
- the **Label Control** dialog box.
- the **Object Properties** dialog box.

Worksheet Data


Display of Numbers that Exceed the Column Width

If a worksheet column contains data that exceed the column width, Origin displays cell value(s) as series of pound signs (#####). The intent is to avoid confusion caused by the truncated display of cell values. Cell values that display as ##### will revert to numbers when you enter cell editing mode.




To disable this feature:

This feature is controlled by a LabTalk numeric system variable. To disable the # sign display:

1. Click the **Script Window**  button.
2. Type the following line in the Script window:

`@wc = 1` <ENTER>

(If you do not see a change when you reactivate the worksheet, click the **Refresh**  button).

To reactivate the # sign display, open the Script Window and type:

`@wc = 0` <ENTER>

To change the column width, see Changing the Column Width on page 41.

A Note on Missing Values in the Worksheet


When spreadsheet programs first appeared it was recognized that there was a need for a special number that was Not-A-Number which would - when used in a calculation - generate itself. Origin has such a number and its internal value is:

`-1.23456789E-300`

Because this value is out of the range of numeric assignment, this provides a way to enter a missing value in a worksheet and use it in calculations.

Origin displays missing values in a worksheet as "--". However, you shouldn't confuse this display (output) with what you enter as a missing value (input).

- If the worksheet column Format is set to **Numeric**, typing any text (for example, "missing" or "--") will set the cell's value to a missing value.
- For column Formats *other than numeric*, you must *manually* enter missing values by typing something that Origin recognizes as invalid for that column type (For example, Origin displays "--" when you type "13" into a cell of a column with Format set to Month).

- To set a missing value in an equation (for example, in the **Set Column Values** dialog box), divide anything by zero.
- If you leave cells blank between the first and last values in a column of data, Origin automatically sets those cell values as missing values. To view the "--" display, you may need to click the **Refresh**  button on the Standard toolbar.

Entering Data using the Keyboard

To enter data directly into the worksheet, type the value into the cell.

- Press ENTER (or the down arrow) to move to the next cell in the same column,
- press TAB (or the right arrow) to move to the next cell in the next column

or

- Click with the mouse in any cell in which you want to enter a value (you are not limited to a neighboring cell).

If you make an error when typing data, or want to change a value in a cell, left-click once in the cell to highlight the cell value and type the correct value. Origin automatically overwrites the value in the cell.

To edit a cell value:

1. Select the cell and then press F2.

or

1. double-click at the desired position to position the cursor in the cell (to prevent overwriting).

To exit the cell editing mode:

1. Press the Up Arrow, Down Arrow, PAGE UP, PAGE DOWN, ENTER, or TAB keys.

This action also moves the cell activity to the new location.

Keys Used for Worksheet Navigation

Key	Description
ENTER	Move the cell activity one cell down.
Left Arrow or SHIFT+TAB	Move the cell activity one cell to the left. If the currently active cell is in the leftmost column of the worksheet, move the cell activity to the rightmost column in the previous row.
Right Arrow or TAB	Move the cell activity one cell to the right. If the currently active cell is in the rightmost column of the worksheet, move the cell activity to the leftmost column in the next row.
HOME	Move the cell activity to the first cell in the column.
END	Move the cell activity to the last cell in the column.
PAGE DOWN	Move the cell activity one page down.
PAGE UP	Move the cell activity one page up.
CTRL+HOME	Move the cell activity to the leftmost cell in the first worksheet row.

Key	Description
CTRL+END	Move the cell activity to the rightmost cell in the last row of the worksheet.
CTRL+PAGE DOWN	Move the cell activity one page to the right.
CTRL+PAGE UP	Move the cell activity one page to the left.
CTRL+Down Arrow	Move the cell activity to the cell with the last value in the column.
CTRL+Up Arrow	Move the cell activity to either the cell with the last value in the column, or to the column's first cell, whichever is the first one upward from the current cell.
CTRL+Left Arrow	Move the cell activity to the cell in the leftmost column in the same row.
CTRL+Right Arrow	Move the cell activity to the cell in the rightmost column in the same row.

Keys Used for Editing

Key	Description
DELETE	Delete one value to the right of the cursor, or delete all highlighted values.
BACKSPACE	Delete one value to the left of the cursor or delete all highlighted values.
HOME	Move the cursor to the leftmost position in the cell.
END	Move the cursor to the rightmost position in the cell.
Left Arrow	Move the cursor one character to the left.
Right Arrow	Move the cursor one character to the right.

Deleting Data

To clear the entire contents of a worksheet (does not delete data sets):

1. Select **Edit:Clear Worksheet**.

An Attention box asks you to confirm clearing the selected cells.

To delete a range of cells, a column, or a row from the worksheet (delete *both* values and cells):

1. Select the desired cells/column(s)/row(s).
2. Select **Edit:Delete**.

Both worksheet values, as well as the worksheet cells, are deleted.

To delete data from the worksheet *without* deleting the corresponding cells:

1. Select the cells containing the data you want to delete.
2. Press the DELETE key.

or

2. select **Edit:Clear**.

Missing values (--) fill the selected cells.

See, *A Note on Missing Values in the Worksheet* on page 61.

Exchanging Worksheet Data Using the Clipboard

Copying Worksheet Data

To copy worksheet data to another application using the Clipboard:

1. Highlight the desired data range and select **Edit:Copy**.

The worksheet data can then be pasted into another Windows application.

Pasting Data into Origin

Use the Clipboard to...

- Paste
- Transpose and Paste
- Paste and Link

...data in the worksheet.

To paste the contents of the Clipboard into a worksheet:

1. Select a cell (or range of cells) in the target worksheet.
2. Select **Edit:Paste**.

To paste a single value into the worksheet:

1. Click on the target cell.
2. Select **Edit:Paste**.

To paste a range of values into the worksheet:

1. Select the cell that is to be the upper-left corner of the range.
2. Select **Edit:Paste**.

To transpose the data when pasting into the destination cells:

1. Select the cell that is to be the upper-left corner of the range.
2. Select **Edit:Paste Transpose**.

To paste and link data:

To link the data when pasting into the destination cells:

1. Select the cell that is to be the upper-left corner of the range
2. Select **Edit:Paste Link**.

This command establishes a **DDE** (Dynamic Data Exchange) link with the source data file.

When the source data changes, the Origin worksheet is updated. When you close an Origin project that has a DDE link, Origin reminds you that this project is linked to another document. The next time you open the project, Origin opens the **Start DDE Link** dialog box. This allows you to re-establish the link with the source file.

If you click **Yes** in the **Start DDE Link** dialog box when the source application is closed, Origin will re-open the source application and file *only if* the source application is in the DOS path and instead opens the Origin file *without* the external link. To ensure that the link to the source file is correctly re-established:

1. Open the source application and file.
2. Return to Origin and click **Yes** in the **Start DDE Link** dialog box.

Exchanging Data Between Worksheets

Data can be exchanged between Origin worksheets, or within a single Origin worksheet, via the Clipboard, or by entering commands in the Script window. When exchanging data via the Clipboard, Origin provides a paste transpose option.

Note: When you enter a numeric value in a worksheet cell, Origin rounds off the displayed value *if* the number of digits after the decimal place exceeds the value specified in the Numeric Display text box, when Set Decimal Places is selected from the Numeric Display drop-down list, both of which are located in the Worksheet Column Format dialog box. Origin uses the entered value in calculations. *However, only the rounded off value is exported to a file or copied to the clipboard.*

Using the Script Window to Exchange Data

LabTalk script can be entered in the Script window for immediate execution. The LabTalk **copy** command can be used to copy a data set from one worksheet to another.

Using LabTalk to Copy Data Sets

1. Click the New Project button on the Standard toolbar to open a new project.
2. Open a second worksheet by clicking the New Worksheet button on the Standard toolbar.
3. Type numeric values in the first four rows of columns A and B in the Data1 worksheet.
4. Click the Script Window button on the Standard toolbar to open the Script window.
5. In the Script window, type the following command and then press ENTER (script is not case-sensitive):

COPY DATA1_A DATA2_A

Execution of this command copies column A of the Data1 worksheet to column A of the Data2 worksheet. If the script does not execute:

1. Check that the **Script Execution** menu command (**Edit:Script Execution**) is selected from the Script window menu bar.
2. Click on the menu command if it is not checked.
3. Place the cursor at the end of your line of code in the Script window.
4. Press ENTER to execute the script.

Creating Data Sets

Assigning Incremental X Values

Use the **For all Worksheet Columns** dialog box to create an X dataset of values with a regular increment (for example, 1, 2, 3, ... , 5, 10, 15, ...) This option is available *only if the worksheet has no X columns*.

To open the **For all Worksheet Columns** dialog box:

1. Select **Format:Set Worksheet X**.

Filling Columns with Row Numbers or Random Numbers

You can fill a column, or a selected range of cells, with:

- **Row Numbers.** To fill with row numbers:

1. Click the **Set Column Values According to Row Number**  button on the Worksheet Data toolbar.

or

1. Select **Column:Fill Column With:Row Numbers**.

or

1. Right-click and select **Fill Column With:Row Numbers**.

- **Uniform Random Numbers.** To fill with uniform random numbers:

1. Click the **Set Column Values with Uniform Random Numbers**  button on the Worksheet Data toolbar.

or

1. Select **Column:Fill Column With:Uniform Random Numbers**.

or

1. Right-click and select **Fill Column With:Uniform Random Numbers**.

For the uniform random number fill, the minimum and maximum numbers generated are determined by the UNIFORM_MIN and UNIFORM_MAX variables. By default, these variables are set to 0 and 1, respectively.

- **Normal Random Numbers.** To fill with normal random numbers:

1. Click the **Set Column Values with Uniform Random Numbers**  button on the Worksheet Data toolbar.

or

1. Select **Column:Fill Column With:Normal Random Numbers**.

or

1. Right-click and select **Fill Column With:Normal Random Numbers**.

For the normal random number fill, the mean and the standard deviation are controlled by the NORMAL_MEAN and NORMAL_SIGMA variables in the [FillColumn] section of the ORIGIN.INI file. By default, these variables are set to 0 and 1, respectively.

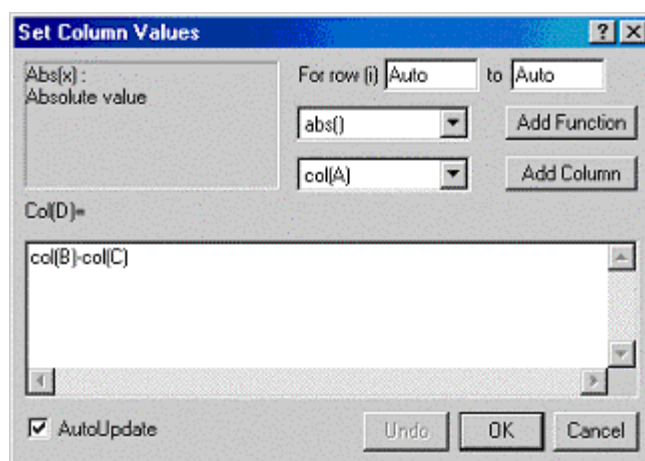
Using Functions to Set Column Values or Mathematically Transform Values

Use the **Set Column Values** dialog box to define a mathematical expression that creates a data set. Your mathematical expression can reference other Origin data sets and can include Origin built-in functions, user-defined and compiled Origin C functions, and LabTalk variables.

To open the **Set Column Values** dialog box:

1. Select a worksheet column or a range of cells in a worksheet column.
 2. From the menu, choose **Column:Set Column Values**.
- or
2. Right-click on the worksheet column and choose **Set Column Values** from the shortcut menu.

Set Column Values Dialog Box Controls



For Row (i) and To

If you select a column or a range of cells in a column prior to opening the Set Column Values dialog box, the beginning and ending worksheet row numbers will automatically register in the **For Row (i)** and **To** text boxes.

To alter the selection range, overwrite the values in these text boxes. Your function will affect only the cells that fall within rows **For Row (i)** and **To**.

To learn more about how the **For...** and **To** settings affect AutoUpdate behavior, see *AutoUpdate of Worksheet Data* on page 69.

Add Function and Add Column

Use the **Add Function** and **Add Column** controls to add mathematical and statistical distribution functions, or data sets within the same worksheet, to the *ColumnName=* text box (without typing out function or data set names).

The **Add Function** list includes Origin's built-in mathematical and statistical distribution functions. When you select a function from the drop-down list, a function summary including a description of the function arguments displays in the left view box. To select a function so that it displays in the **ColumnName=** text box:

1. Select your function from the **Add Function** list.
2. Click the **Add Function** button.

If text was highlighted in the **ColumnName=** text box, that text becomes the (last) argument for the chosen function. If *no* text was highlighted, the function is entered at the last active cursor location.

The **Add Column** list includes an entry for each column in the active worksheet*. To add a dataset to an expression in the **ColumnName=** text box:

1. Select a column from the **Add Column** list.
2. Click the **Add Column** button.

If text was highlighted in the **ColumnName=** text box, Origin overtypes this text with the chosen column name. If *no* text was highlighted, the column name is entered at the last active cursor location.

*Reference data sets in other worksheets using the **WorksheetName_ColumnName** syntax. For example, to specify the C column in the Data3 worksheet, you can type Data3_C.

The **ColumnName=** Text Box

Define an expression that creates a dataset in the selected worksheet column cells. The expression can reference any data sets (columns) in the project. Definitions must use the standard Origin arithmetic operators and Origin built-in or LabTalk-callable user-defined Origin C functions.

- Use any of Origin's built-in functions, following the syntax described in the **LabTalk Language Reference Section** of the Programming Help file (**Help:Programming**).
- Use a LabTalk variable.
- Use a LabTalk-callable Origin C function.

Use the variable **i** in your expression to indicate row number. For example, the expression **col(A)=i** fills column A with row number values.

Reference data sets in other worksheets using the **WorksheetName_ColumnName** syntax. For example, to specify the C column in the Data3 worksheet, you can type **Data3_C**.

Note: LabTalk expressions end with a semi-colon. However, you do not include a semicolon after the expression entered in the **Set Column Values** dialog box.

The **OK** Button

Closes the dialog box and sets the values for the selected cells according to the expression in the **ColumnName=** text box.

The **Undo/Redo** Button

Undo/Redo the last change made to the expression in the **ColumnName=** text box.

The **AutoUpdate** Check Box


Note: You can enable an AutoUpdate of column values when source data are changed; by default, AutoUpdate is disabled. If AutoUpdate is disabled, you can update all data sets in the active worksheet by:

1. Selecting the the menu command **Analysis:Set All Column Values**.

2. Selecting the **Set All Column Values** button .

Values in the active worksheet are updated, starting from the left-most column and moving to the right.

AutoUpdate is *not* sensitive to column position *and* allows references to source data in other worksheets (Set All Column Values acts only on the *active* worksheet).

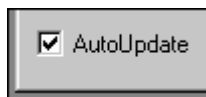
 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

AutoUpdate of Worksheet Data

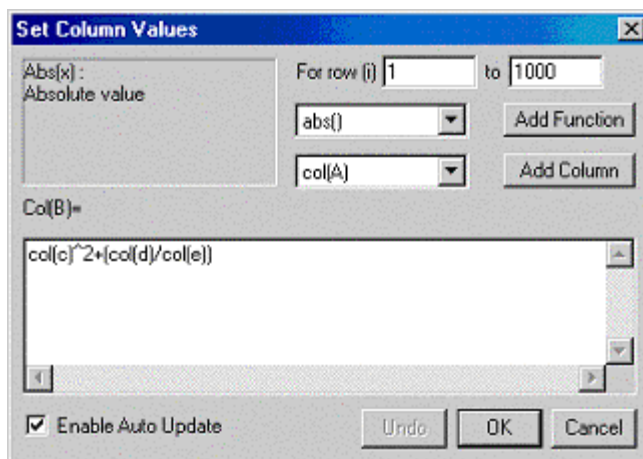
This feature lets you create a mathematical relationship between data values in two or more worksheet columns and to have the values in the target (dependent) column(s) update automatically any time data in the source column(s) are modified. **AutoUpdate** supports referencing of *any* worksheet data set in the Origin project (see below).

Mathematical relationships are established via the **Set Column Values** dialog box. To open the Set Column Values dialog box for a worksheet column:

1. Select the column and choose **Set Column Values** from either the shortcut menu or from the Column menu (**Column:Set Column Values**).
2. Enable **AutoUpdate** by selecting the box at the bottom of the dialog.



If **AutoUpdate** is selected, column values in rows **For Row (i)** to **To** (of the **Set Column Values** dialog box) are updated whenever values in other columns referenced in the **col(ColumnName)=** text box are changed.

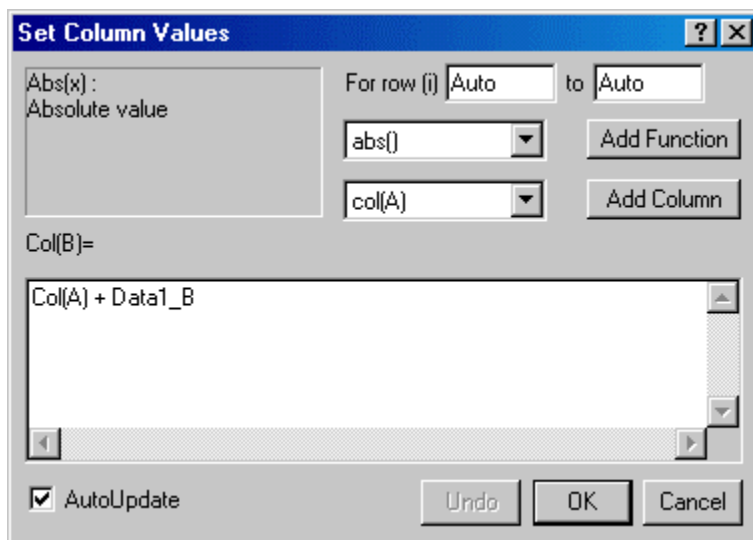


Col(ColumnName) formulae can refer to:

- Other columns in the same worksheet (using the **col(ColumnName)** notation).
- Columns in other worksheets (using the **WorksheetName_ColumnName** notation).


Example:

You have two worksheets named **Data1** and **Data2**. You open the Set Column Values dialog box for column **B** of worksheet **Data2** and you enter...



... then check the **AutoUpdate** check box.

Whenever values in Col(A) of worksheet Data2 and/or Col(B) of worksheet Data1 change, values in column Data2_B are automatically updated.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Note: Cyclical referencing is checked for, reported, and not permitted.

When AutoUpdate is enabled for a column of data, the column is *locked* for editing. This condition is indicated by the lock icon on the column header. AutoUpdate is disabled by default.



When **AutoUpdate** is enabled, the default value of **For Row (i)** and **To** is **Auto** (internally, this value = -1); this is to indicate that all rows auto-track the source column(s). You can specify a subrange of rows manually. In such cases, *any* change to data in a source column(s) will trigger the AutoUpdate routine, but only changes in source data within the destination column's **For Row (i)** and **To** range will update values in the destination column.

Note that you can use this feature to call Origin C functions in the Set Column Values dialog box that take **double** or **vector** as an argument. To see an example of an OPJ with an attached OC file, whose functions are used in the Set Column Values dialog box with AutoUpdate enabled, see the project \Samples\Programming\Passing Vectors\PassingVectors.OPJ

Programming Notes:

The AutoUpdate process occurs while Origin is idle. When using this feature in the user-interface -- as when you are modifying source data by direct edit, by copy/paste, or by data import -- the destination column(s) will be seen to update immediately.

This does *not* occur in the programming environment. If you programmatically change the source data, and want the column values updated before executing the next command/statement, you must *force* an AutoUpdate.

In Origin C, there is a **Project.Run()** method for forcing an AutoUpdate.

In LabTalk, the equivalent command is **run -p au**.

Note that forcing an update will update *all* destination columns whose source data has changed.

Sample LabTalk code:

```
data1_a=normal(30);
run -p au;
sum(data1_b);
sum.total=;
```

In this example...

- It is assumed that column data1_b will AutoUpdate when changes occur in data1_a.
- The **run -p au** command on the second line ensures that data1_b is updated before subsequent lines of code use the values in data1_b.
- Leaving out the **run -p au** line will result in *old values* of data1_b being used for the subsequent computations.

Note: A system variable, **@au**, controls AutoUpdate behavior. By default, **@au =1**, in which case AutoUpdate is performed on idle. If you set **@au =0**, AutoUpdate must be triggered manually (as with the **run -p au** command).

Importing Data into a Worksheet Window

Importing ASCII Files

Importing a Simple Single ASCII Data File into the Worksheet

The **File:Import:Simple Single ASCII/Multiple ASCII** methods are an older Origin feature. For import of ASCII, as well as binary and user-defined file types, we recommended that you use the Origin Import Wizard. The following information is provided simply for those who choose to use the older ASCII Import methods.

To import a single ASCII file into the active worksheet:

1. Click the **Import ASCII** button  on the Standard toolbar.

or

1. Select **File:Import:Simple Single ASCII**. This menu command opens the **Import ASCII** dialog box.
2. Select the file extension from the **Files of Type** drop down list, specify a **File Name**, and click **Open**.

Origin uses the default import settings specified in the **ASCII Import Options for Worksheet** dialog box to import the data file. In many cases, the default import settings are adequate to import your data file (Origin examines the data file, looks for columns of numbers and ignores anything else).

This method will prove inadequate for more complex files, in which case, you will need to specify the data structure and import settings explicitly. You can take either of two approaches:

Use the **Import Wizard** to show Origin how to parse your data file (recommended). Optionally, create a filter file and save it for future use with the same or similar data files. For information on using the Import Wizard to import your ASCII files, see The Import Wizard.

or

You could customize the **ASCII Import Options for Worksheet** dialog box settings and try re-importing the file. For information on customizing the import settings, see the next topic: Customizing the Default ASCII Import Settings.

Customizing the Default ASCII Import Settings

The **File:Import:Simple Single ASCII/Multiple ASCII** methods are an older Origin feature. For import of ASCII, as well as binary and user-defined file types, we recommended that you use the Origin Import Wizard. The following information is provided simply for those who choose to use the older ASCII Import methods.

To view the default import settings ASCII import settings for the active worksheet window:

1. From the Origin menu, select **File:Import:ASCII Options**.

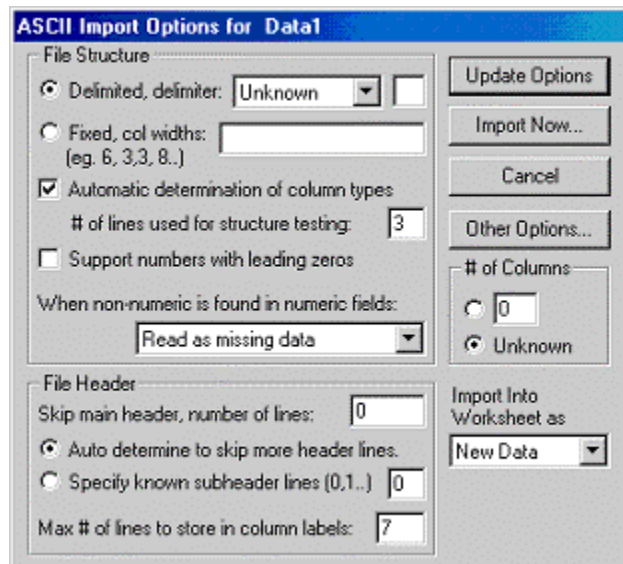
or

1. Click **Options** in the **Import ASCII** dialog box (this dialog box opens when you select **File:Import:Simple Single ASCII** or **Multiple ASCII**).

The default settings in the **ASCII Import Options for Worksheet** dialog box are stored with the worksheet template and are modifiable.

- To modify import settings for the active worksheet, make your changes and click **Update Options**.
- To establish new default settings, you must save the active worksheet as a template. To save the worksheet as a template, select **File:Save Template As**.

The ASCII Import Options for Worksheet Dialog Box



The File Structure Group

There are two types of ASCII files: those in which data are *delimited* by a character (typically a comma, tab, or white space), and *fixed column* files that specify the width of columnar fields.

Origin can usually guess the correct file structure when importing a file, but will sometimes have difficulty with very complex files. You can often solve the problem by specifying the file structure, if known.

For a delimited file, select a delimiting character from the Delimited, Delimiter drop-down list, or select Other from the drop-down list and enter the delimiting character in the associated text box. If you select Unknown, Origin will search your file, looking for a consistent delimiter. If the file uses a consistent delimiter, Origin will determine the file structure.

For a fixed column file, specify the width of each columnar field in the associated text box. Separate each value with a comma. Origin uses the last number entered to set the width for all remaining columns. If you enter a single width value, Origin sets all columns to that width.

When the Automatic Determination of Column Types check box is selected, Origin automatically determines whether each column contains text or numeric data, and sets each worksheet column type accordingly. When the check box is cleared, Origin retains the column type settings of the worksheet into which you are importing data.

Specify the number of lines used for structure testing in the associated text box. Enter a number which is greater than the header size, but smaller than the size of the file.

If your data file contains zero-padded data (data with leading zeros), select the Support Numbers with Leading Zeros check box to properly import the data.

When importing a file, Origin looks at the contents of the first few cells to determine if a column contains numeric or non-numeric information. The When Non-Numeric is Found in Numeric Fields drop-down list selection controls how Origin proceeds if non-numeric information is encountered in a numeric column after the header. Select an option from the associated drop-down list.

The File Header Group

The number of lines that should be ignored before Origin starts importing data is specified in the Skip Main Header, Number of Lines text box. Select the Auto Determine to Skip more Header Lines radio button to cause Origin to skip lines until it encounters a consistent and recognizable file structure. You can also select a specific number of sub-header lines to skip by selecting the Specify Known Subheader Lines (0,1...) radio button and editing the associated text box.

You can store text from the file header in the worksheet's column labels. This option is provided by the "Max # of Lines to Store in Column Labels" text box. By default, up to seven lines of header text can be stored in the column labels.

The # of Columns Group

When the Unknown radio button is selected, Origin imports all columns in the file. You may also specify x number of columns for Origin to import. If the file you want to import contains more than x columns, only the first x columns import. If the file contains less than x columns, the entire file imports. Origin does not create additional worksheet columns.

The Import Into Worksheet as Drop-down List

This option determines how the imported data is added to the active worksheet. The New Data option enables overwriting of the existing worksheet data. The New Columns option adds new columns to the right of the current columns in the worksheet, as necessary, to accommodate the data. The New Rows option adds new rows to the bottom of the worksheet, as necessary, to accommodate the data.

Note: If you are importing your data into new columns and a column name in your file duplicates a column name already used in the worksheet, you can append the file's column name into the worksheet column's label field. To do this, open the Data Import Options for *Worksheet* dialog box (**File:Import:Other Options**), and select the Create Column Labels from Header check box.

Now when you plot your data, Origin will automatically include the column label information in the graph legend.

The **Import Now** Button

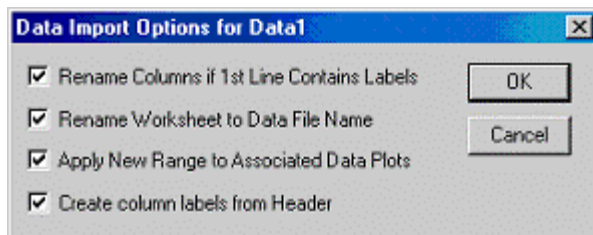
Click Import Now to import the ASCII file after you are satisfied with the dialog box settings. Origin updates the worksheet and opens the Import ASCII dialog box, from which you select an ASCII file. The file is imported using the current dialog box settings.

The **Update Options** button

Click Update Options to save the current settings into the active worksheet and close the dialog box.

Click the **Other Options** button to open the **Data Import Options for Worksheet** dialog box. This dialog box provides additional control for importing ASCII files.

The Data Import Options for Worksheet Dialog Box



The **Rename Columns if 1st Line Contains Labels** Check Box

If selected, this check box directs Origin to take the first line of the imported file that contains text, and use the text to name the worksheet columns.

The **Rename Worksheet to Data File Name** Check Box

If selected, this check box directs Origin to change the name of the active worksheet to the name of the imported file.

The **Apply New Range to Associated Data Plots** Check Box

If this check box is selected, the display range is set to encompass all of the imported data. If this check box is cleared, the current worksheet display range settings remain in effect. Clearing this check box lets you view a specific range of data from a series of imported data files. For example, if you have plotted a column of worksheet data and set the display range from row 10 to row 35, only imported data points in these rows display.

The **Create Column Labels from Header** Check Box

If selected, this check box directs Origin to append the import file column names to the associated worksheet column labels. Origin automatically displays the column labels after importing the file.

A Note on Importing Your Data Set and Displaying File Labels in the Column Name and Column Label Fields

If your data file includes two lines of column information, such as the following data file, you can display the file's column names (Thrust and Pitch) in the worksheet column name field, and both the file's column names and labels (Thrust and Pitch, Lbs and Deg)

in the worksheet column label field. Doing this allows you to maximize the data set information displayed by default in the graph legend.

Thrust	Pitch
Lbs	Deg
1	4
2	56
3	42
etc...	

To display the file's names and labels in the worksheet, select the Rename Columns if 1st Line Contains Labels check box *and* the Create Column Labels from Header check box in the Data Import Options for *Worksheet* dialog box. After importing the data file, Origin automatically displays both header lines in the worksheet column label fields.

Thrust(X)	Pitch(Y)
Thrust	Pitch
Lbs	Deg
1	4
2	56
3	42
etc...	

When you highlight and plot the data, the worksheet's column labels display in the graph legend by default.

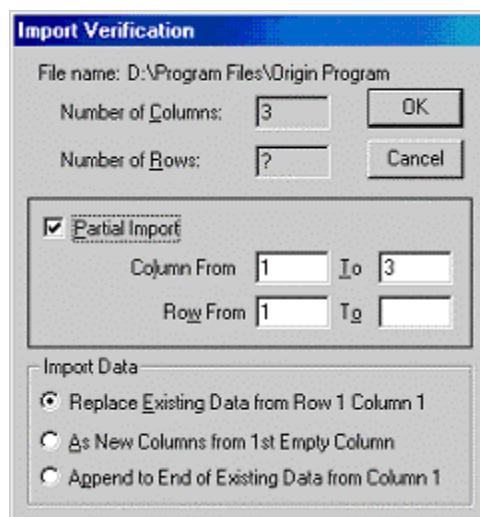
Importing a Range of an ASCII File

The **File:Import:Simple Single ASCII/Multiple ASCII** methods are an older Origin feature. For import of ASCII, as well as binary and user-defined file types, we recommended that you use the Origin Import Wizard. The following information is provided simply for those who choose to use the older ASCII Import methods.

To import a selected range of an ASCII file:

1. Select the **Partial Import** check box in the **Import ASCII** dialog box (**File:Import:Simple Single ASCII**). After selecting your file and clicking Open, Origin opens the Import Verification dialog box. Edit this dialog box to specify a range for partial import.

The Import Verification Dialog Box



The path and file name for the data file is displayed at the top of this dialog box. In addition, the number of columns and rows in the file are displayed in the associated list boxes.

The Partial Import Group

Select the **Partial Import** check box to import a range of the ASCII file.

Specify the file import range by typing the desired **From** and **To** limits in the **Column** and **Row** text boxes.

The Import Data Group

Select the **Replace Existing Data from Row 1 Column 1** radio button to replace the existing data in the destination worksheet.

Select the **As New Columns from 1st Empty Column** radio button to add the import data to the first empty column to the right in the worksheet. This column is created if necessary.

Select the **Append to End of Existing Data from Column 1** radio button to append the import data to the first available row in the worksheet, starting with column 1.

Note: The Import Wizard also supports partial import of files. For more information, see *The Import Wizard* on page 86.

Importing Multiple ASCII Data Files into a Single or Multiple Worksheets

The **File:Import:Simple Single ASCII/Multiple ASCII** methods are an older Origin feature. For import of ASCII, as well as binary and user-defined file types, we recommended that you use the Origin Import Wizard. The following information is provided simply for those who choose to use the older ASCII Import methods.

You can use the **File:Import:Multiple ASCII** menu command to import multiple ASCII data files into the same worksheet (as new columns), or into separate worksheets.


- When importing into the same worksheet (as new columns), Origin uses the **Import ASCII Options for Worksheet** dialog box settings for the active worksheet to determine the data file structure.
- When importing into separate worksheets, you can select the worksheet template for each data file. Thus, for each data file, Origin uses the **Import ASCII Options for Worksheet** dialog box settings for the selected worksheet template to determine the data file structure.

To learn about the **Import ASCII Options for Worksheet** dialog box, see *Customizing the Default ASCII Import Settings* on page 72.

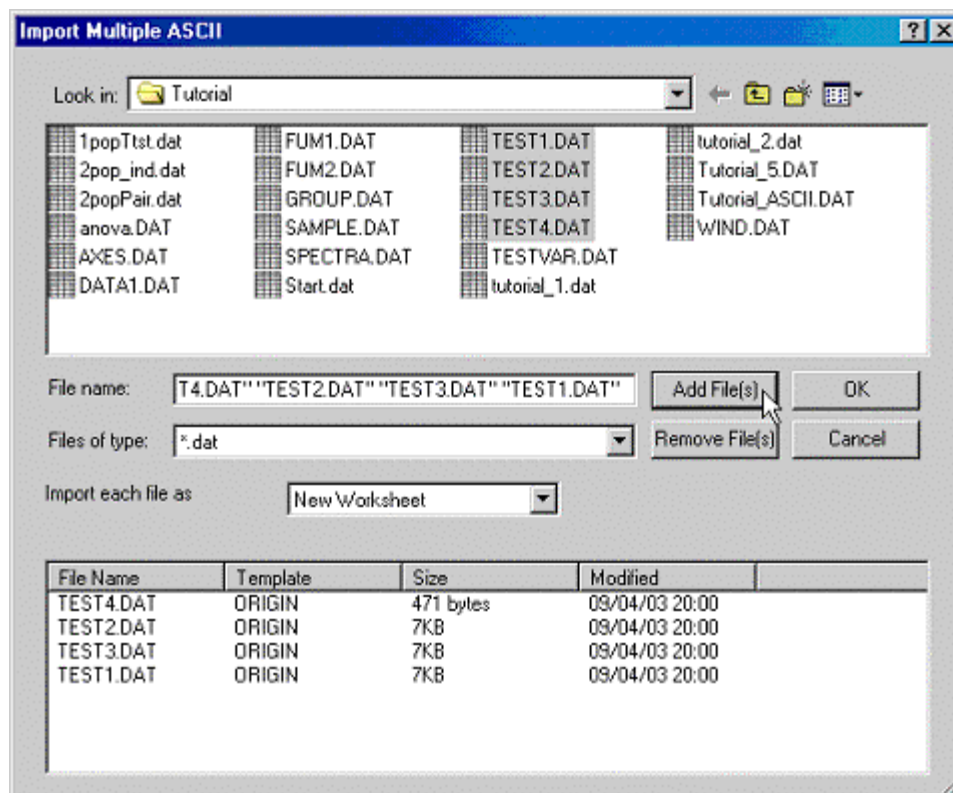
To import multiple ASCII data files into a worksheet or worksheets:

1. Select **File:Import:Multiple ASCII** when a worksheet is active.

or

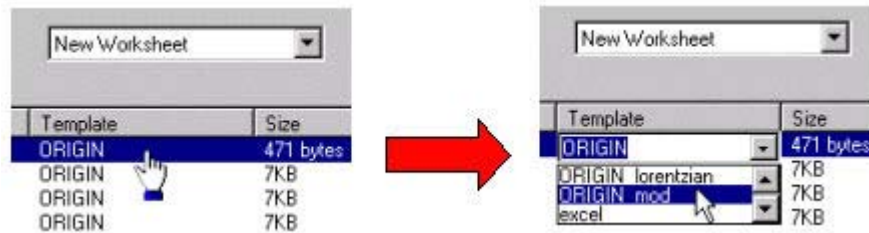
1. Click the **Import Multiple ASCII** button  on the Standard toolbar when a worksheet or graph window is active.

This opens the **Import Multiple ASCII** dialog box.



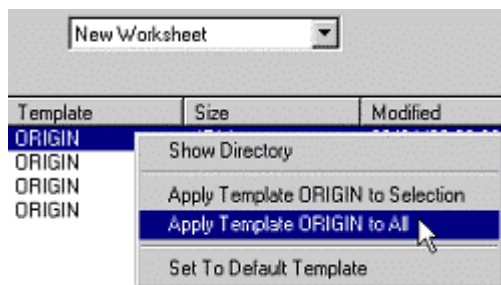
2. Press CTRL or SHIFT + select to select your files, then click the **Add Files** button.
 - To import the files into separate columns of the active worksheet, select **New Columns** from the **Import Each File As** drop-down list.
 - To append each file to the previously imported file in the active worksheet, select **New Rows** from the **Import Each File As** drop-down list.
 - To import the files into separate worksheets, select **New Worksheet** from the **Import Each File As** drop-down list.

Note that if you choose **New Worksheet**, you can specify a separate worksheet template for each imported file.



In addition to specifying a separate worksheet template for each imported file, you can apply your Template selection to some or all of the data files in the list box.

- To apply the selection to *all* data files, right-click on the template in the Template column and select **Apply Template Template to All** from the shortcut menu.
- To apply the selection to *selected* data files, select the data files in the list box, then right-click on the template in the Template column and select **Apply Template Template to Selection**.



Note that you can also set the selection to the **Default** template from this shortcut menu. The default template is controlled by the **Default Multi-ASCII Import Template** selection on the **Miscellaneous** tab of the Options dialog box (**Tools:Options**).

Importing dBASE Files

Origin supports dBASE II, dBASE III, dBASE III Plus, and dBASE IV.

To import a dBASE file into the active worksheet:

1. Select **File:Import:dBASE**.

Importing DIF Files

To import a DIF file into the active worksheet:

1. Select **File:Import:DIF**.

Importing Kaleidagraph Binary Data

To import Kaleidagraph binary data into the active worksheet:

1. Select **File:Import:Kaleidagraph**.

Importing LabTech Files

To import LabTech binary real and binary integer formats into the active worksheet:

1. Select **File:Import:LabTech**.

Note: Other LabTech formats are text-based and are imported as ASCII files.

Importing Lotus Files

Origin supports Lotus version 1.x, 2.1, 3.x, 4, and 5.

To import a Lotus file into the active worksheet:

1. Select **File:Import:Lotus**.

Importing Mathematica (Vectors and Matrices)

To import Mathematica (vectors and matrices) into the active worksheet:

1. Select **File:Import:Mathematica**.

Note: An "Origin Link for Mathematica" tool is also available from the **File Exchange** page (formerly the Add-on Modules page) of the OriginLab website. A summary of this tool follows:


"This link between Origin and Mathematica 4.0 combines the computational power of Mathematica with the intuitive graphing capabilities of Origin. The link provides a multi-tabbed dialog box that allows transfer of data and expressions between Mathematica and Origin. Any Mathematica expression can be entered and results viewed in a scrollable window. You can use Mathematica's kernel to transform your data and then use Origin to graph the results. The link provides a complete solution for advanced mathematical analysis and flexible, interactive graphing."

Importing MATLAB Files

To import MATLAB data variables that have been saved in a MATLAB Workspace file (*.MAT):

1. Select **File:Import:MATLAB**. This opens the **Open** dialog.
2. Browse to the saved file, select it, and click **OK**.

This opens the **MATLAB Import** dialog box. This dialog box is the same as that launched by the **Import** button on the **MATLAB Console** dialog box, available from the Tools menu (**Tools:MATLAB Console...**). However, the Import button on the Console allows import of variables from the *current* MATLAB workspace. The **File:Import:MATLAB** menu command only allows import of variables from a *saved workspace file*.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Note1: The **File:Import:MATLAB** menu command does *not* require that you have MATLAB installed on your computer.

Note 2: Origin 7.5 supports import of **numeric** or **character** arrays and **sparse** arrays. It does *not* support import of **3D** (or greater) arrays, **cell** arrays, **structures** or **objects**.

Importing pCLAMP Data Files

Plotting PCLAMP Data

A special graph template, PCLAMP.OTP, is provided for plotting your pCLAMP data.

To plot your pCLAMP data using the PCLAMP.OTP template:

1. Select your worksheet data.
2. From the menu, choose **Plot:Template Library**. This opens the **Select Template** dialog box.

If you have not added the PCLAMP.OTP graph template to your template library, it will not be visible.

To add PCLAMP.OTP to your template library and plot with the template, do the following; if you *have* already added PCLAMP.OTP to your template library, skip to step 8.

3. In the **Category** group, click **New**.
4. In the **Add New Category** dialog box, type the word **pCLAMP**.
5. With the **pCLAMP** category highlighted, click **Add** in the **Template** group. The **Open** dialog box opens.
6. Browse through the list of OTP files in your Origin folder and select PCLAMP.OTP.
7. Click **Open**.
8. With the **PCLAMP** template highlighted, click **Plot**.

Your pCLAMP data is plotted to PCLAMP.OTP. A Reminder Message may tell you that your graph is displayed in Speed Mode.

The pCLAMP graph window includes two tools to aid in examining regions of your data: the **Scale** object and the **X Value Indicator** object.

The Scale Object

The Scale object is a movable XY scale which displays the current X and Y axis scales. This object provides an extra display of the current axis scales anywhere in the graph window. To move the Scale object, drag the object to the desired location. To modify the range of the Scale object, click **Resize Scaler** on the pCLAMP graph window. Select the desired Scale object range in the **Set Scaler Range** dialog box. Click **OK** to close the dialog box and display the modified object.

To customize the display of the Scale object, double-click on the object to open the **Scale Object** dialog box. The **Scale Object** dialog box provides options to customize the titles, scale, range, color, line width, ticks, gaps, and font of the Scale object.

The X Value Indicator Object

The X Value Indicator consists of a vertical line on the graph and an X Value display object. The display object reflects the X value of the vertical line. To display the X value within the graph window, drag the line to the desired area.

To edit the display of the vertical line, double-click on the line to open the **Arrow Control** dialog box. Select the desired dialog box settings and click **OK** to close the dialog box and update the vertical line.

Adding a Scale Object to Your Graph

The scale object is intended for use with the pCLAMP plotting template (PCLAMP.OTP). The scale object aids in display and analysis of the pulse waveforms common to electrophysiology work.

To add an XY scale object to your graph:

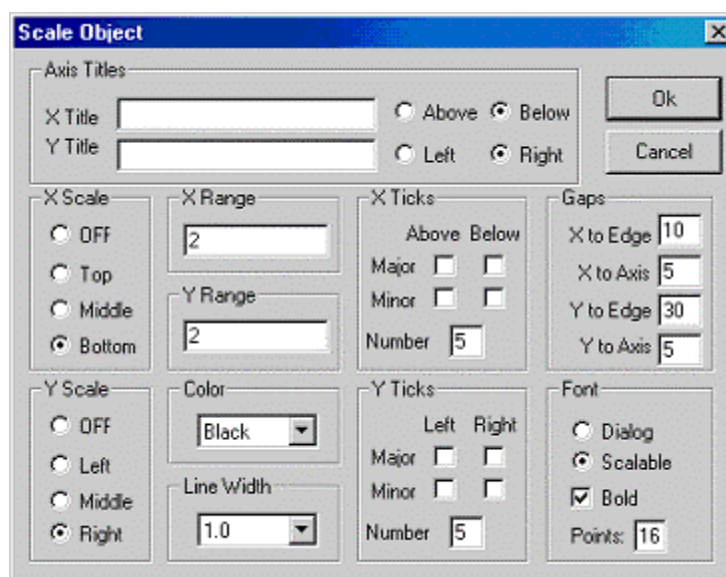
1. Click the **Add XY Scale** button  on the Graph toolbar to add a movable XY Scale to your graph.

Once added, you can move the object anywhere on the graph.

By default, the XY Scale displays the scale of the current X and Y axes' major tick scales. You can customize the object's X and Y scale range by double-clicking on the object to open the **Scale Object** dialog box. This dialog box also provides controls for adding titles and ticks to the XY Scale object.

Note: After making changes to the XY Scale object dialog box and clicking **OK**, you may need to select **Window:Refresh** to view the changes to the XY Scale object.

The Scale Object Dialog Box



The Axis Titles Group

Type the desired X and Y axis title in the **X Title** and **Y Title** text boxes.

Control the display position of the object's X and Y axis titles by selecting the desired radio button in this group.

The X (and Y) Scale Group

Control the position of the object's X (or Y) axis by selecting the desired radio button in this group. To disable the X (or Y) axis display, select **Off**.

The X (and Y) Range Text Box

Control the object's X (or Y) range by typing the desired value in this text box.

The Color Drop-Down List

Select the desired object color from this drop-down list.

The Line Width Drop-Down List

Select the desired line width for the display of the object's axis from this drop-down list.

The X (and Y) Ticks Group

Control the display of major and minor X (or Y) axis ticks in this group. Set the total number of major ticks in the **Number** text box.

The Gaps Group

Set the distance between the edge of the page and the object's X axis in the **X to Edge** text box.
Set the distance between the object's X axis title and the X axis in the **X to Axis** text box.

Set the distance between the edge of the page and the object's Y axis in the **Y to Edge** text box.
Set the distance between the object's Y axis title and the Y axis in the **Y to Axis** text box.

The Font Group

Select the **Dialog** radio button to display the object's axis title using a font which can be adjusted to incremental sizes. This selection is preferred when displaying a small font size. Select the **Scalable** radio button to display the object's axis title using a font which can be adjusted to any size. This selection is preferred when displaying a larger font size.

Select the desired font size from the **Points** text box. To bold the axis titles, select the **Bold** check box.

Importing Minitab Data

To import a Minitab worksheet or project using a menu command:

1. Select **File:Import:Minitab**.

To import a Minitab worksheet or project by drag-and-drop:

1. Select your file(s) in Windows Explorer.
2. Drag the file(s) to the Origin taskbar button and hold there until the Origin workspace is restored.
3. Drop the files onto the Origin workspace.

Minitab data files are always imported into a new worksheet, regardless of where you drop them in the workspace.

Importing SigmaPlot Files

Origin will import these SigmaPlot files:

- SP5, SigmaPlot for DOS.
- SPW, SigmaPlot for Windows (v.1 and 2).
- JNB, SigmaPlot for Windows (v.3, 2000, and 2001).

To import a SigmaPlot file into the active worksheet using a menu command:

1. Select **File:Import:SigmaPlot**.

To import a SigmaPlot file by drag-and-drop:

1. Select your file(s) in Windows Explorer.
2. Drag the file(s) to the Origin taskbar button and hold there until the Origin workspace is restored.
3. Drop the files onto the Origin workspace.

SigmaPlot data files are always imported into a new worksheet, regardless of where you drop them in the workspace.

Importing Sound Files

To import a Sound (WAV) file into the active worksheet:

1. Select **File:Import:Sound**.

Importing Thermo Galactic SPC Data Files

To import Thermo Galactic SPC data files from the Origin menu:

1. Select **File:Import:Thermo Galactic (SPC)**.

To import Thermo Galactic SPC data files by drag-and-drop:


1. Select your file(s) in Windows Explorer.
2. Drag the file(s) to the Origin taskbar button and hold there until the Origin workspace is restored.
3. Drop the files onto the Origin workspace.


SPC files dropped into a worksheet are imported into that worksheet. Files dropped into an empty portion of the workspace are imported into a new worksheet.

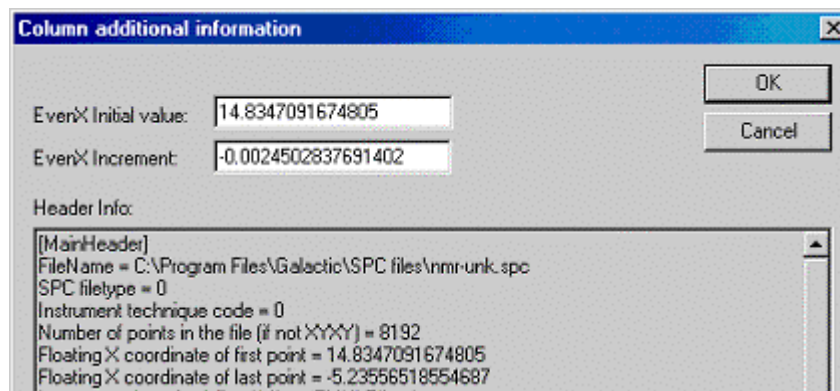
Origin supports both single and multiple data arrays.

- If the data file contains an array of X values, then Origin assigns those values to an X column.
- If the initial X value and the increment are stored in the header, then Origin creates a hidden X column with the correct **starting value** and **increment**.

To view or edit the starting value and increment in Origin, do one of the following:

- ⇒ Double-click on the page symbol  located in the upper-left corner of the column heading. This opens the **Column Additional Information** dialog box. You can modify the **EvenX Initial Value** and **EvenX Increment** in the associated text boxes.

	 A[Y]	B[Y]
1	-0.01573	
2	-0.01636	
3	-0.0161	
4	-0.01585	



- ⇒ Click on the worksheet column heading to select the column, then select **Format:Set Worksheet X**. This menu command also opens a dialog box for modifying the starting X value and increment.

Origin's Drag-and-Drop Data File Support for Worksheets

Origin supports drag-and-drop import of ASCII, simple binary, SigmaPlot, Minitab, Thermo Galactic SPC, and user-defined file types.

To drag and drop files onto Origin:

1. Select your file(s) in Windows Explorer.
2. Drag the file(s) to the Origin taskbar button and hold there until the Origin workspace is restored.
3. Drop the files onto the Origin workspace.
 - For ASCII, binary, and user-defined file types not handled by DOFILE.OGS, drag-and-drop behavior is dependent upon (a) where the file was dropped and (b) your import filter (OIF) file settings.

Origin's Drag-and-Drop file import routines are handled by one of two methods:

- ⇒ The older method involves calling a LabTalk section in a file called DOFILE.OGS (see *A Note on Adding Drag-and-Drop Support for New File Types*, below). This user-modifiable file is installed as part of your Origin software. This file has been used by Origin to import SigmaPlot, Minitab, and Thermo Galactic SPC data files and you may have modified this file yourself, adding your own LabTalk script to handle drag-and-drop import of unrecognized (by Origin) data files.
- ⇒ The newer method relies on user-created Origin Import Filter (OIF) files, created using the Origin Import Wizard.

When ASCII, binary, or user-defined file types are dropped into the Origin workspace, Origin first looks for data handling instructions in DOFILE.OGS. If they are not found there, Origin looks for an appropriate OIF file. If no OIF file exists, the Import Wizard is opened.

If Origin *does* find that an appropriate OIF exists for handling the "dropped" file, it will import the file automatically (without opening the Import Wizard) into the OIF **Target Window**.

- If the file is dropped onto an active Target Window, data are imported into the Target Window regardless of whether a custom **Target Window Template** was specified in the OIF.
- If the file is dropped onto an empty portion of the workspace or onto a window type that is *not* the Target Window type, data are imported into the Target Window Template (which is the default Origin worksheet template unless otherwise specified).
- If multiple files are dropped onto an active Target Window, the first file is imported into the active Target Window. Remaining files will go into the *same* window if the **Import Mode** is **Start New Rows** or **Start New Columns**, or into a *new* window created from the Target Window Template if Import Mode is set to **Replace Existing Data** (see **Note** below).
- If multiple files are dropped onto an empty portion of the workspace or onto a window type that is not the Target Window type, data are imported into one or more windows (depending on the Import Mode setting) created from the Target Window Template.

As a rule, any time a Target Window needs to be created, Origin does so using the Target Window Template.

Note: If you drop a file onto an active Target Window, existing data in that window will be overwritten if the OIF **Import Mode** is set to **Replace Existing Data**. *If you do not want existing data to be overwritten, then do not drop onto a Target Window; instead drop the file(s) onto an empty portion of the workspace.*

- Thermo Galactic SPC files dropped into a worksheet are imported into that worksheet. Files dropped into an empty portion of the workspace are imported into a new worksheet.
- SigmaPlot and Minitab data files are always imported into a new worksheet, regardless of where you drop them.

A Note on Adding Drag-and-Drop Support for New File Types

Origin provides two mechanisms by which you can add drag-and-drop support for user-defined file types:

- Create a filter using the Import Wizard.

This method requires that you supply the import code in the form of an Origin C function.

Your Origin C function should have the following prototype:

```
int YourFunctionName(Page& pgTarget, TreeNode& trFilter,
LPCSTR lpCszFile, int nFile)
```

where:

pgTarget: A reference to a Page object of type worksheet or Matrix. This would be what you defined in your filter or on the 1st page of the wizard, as the target window.

Note1: The target window and template specification on Page 1 is only used when creating new windows (as would be the case when you use **File:Open** or under some conditions during drag-and-drop importing). When choosing **File:Import**, if your active window is of the same type as your target window specification, no new window is created and a reference to the page object for the active window is passed to your function. If the active window *is* of a different type, a new window is created using the specified template, and the page reference to this new window is passed.

trFilter: A reference to a TreeNode object that holds all the filter settings from your filter file, or from your wizard specifications, in a tree structure.

lpCszFile: The full path and name of the file that is being imported.

nFile: The file index number in an ordered sequence of imported files (e.g. If you drag-and-drop *n* files, or try to **Open/Import***n* files, your function gets called *n* times, and **nFile** is the file count for the file being processed.

Note2: For an example that illustrates writing a custom function, refer to the OC file \OriginC\OriginLab\EarthProbe.c. This file is used by Origin for importing Earth Probe data.

- Add a section to the DOFILE.OGS script file.

When any file is dropped onto Origin from Windows Explorer, Origin looks to the DOFILE.OGS script file located in your Origin folder. It then looks for a section named [OnOpen*Extension*], where *Extension* is the file extension of the dropped file. If found, that section is executed and the file name is passed as an argument.

To learn more about this method, review the AUTOMATION.OPJ sample project located in your Origin \SAMPLES\PROGRAMMING\AUTOMATION subfolder.

Note: Because Origin looks to DOFILE.OGS before looking to see whether there is an Import Wizard filter (*.OIF) file for the dropped file type, you must remove any previously added file import code from DOFILE.OGS if you plan to use an .OIF file to import your user-defined files.

Import Wizard

The Import Wizard provides control over import of ASCII, simple binary (header followed by simple binary structure), and user-defined file types. The wizard can be used to create custom settings for each file type. Wizard settings can be saved as filters for later use with the same or similar files.

Overview of features

Applicable Data Import Methods

Use the wizard to specify how data is imported when:

- Opening data files using the **File:Open** dialog.
- Importing data files using the **File:Import** menu.
- Dragging-and-dropping data files into the Origin workspace.

For the ASCII and binary file types, the wizard leads you through a series of pages on which you select your import options. Origin then uses these options to read your file and subsequently imported files that share the same structure.

For importing of user-defined file types, you supply the import code in the form of an Origin C function.

Target Page Sensitivity

The Import Wizard supports file import to these Origin child windows:

File Type	Possible Target Window(s)	Paste Clipboard Data?
ASCII	worksheet	Y
Simple binary	worksheet	N
User-defined	worksheet or matrix	Y

Some Wizard options are Target Window sensitive; the option will not be seen if it is not applicable to a the Target Window. Further, you can specify different treatments for files that are dragged-and-dropped onto worksheets, dragged and dropped onto graphs, etc.

Saving Your Import Filters

All wizard settings can be saved to filters for later use. These filters can be saved in two ways:

- They can be saved as .OIF (Origin Import Filter) files in the Microsoft XML format.
- They can be stored in the Target Window template.

When saving as an .OIF file, you can save the filter to the same folder as the data file, or you can save the filter to a general Filters folder in the User Files area. You can define wild cards for each filter file, allowing you to specify that a filter apply to multiple file types.

When you import by drag-and-drop, Origin looks for an appropriate filter for the files being dropped. Origin searches the subfolder containing the data files first, then searches the general Filters folder. If multiple applicable filter files are found, a dialog opens listing all filters in the folder, and the user selects a filter from the list.

Support for Multi-File Import

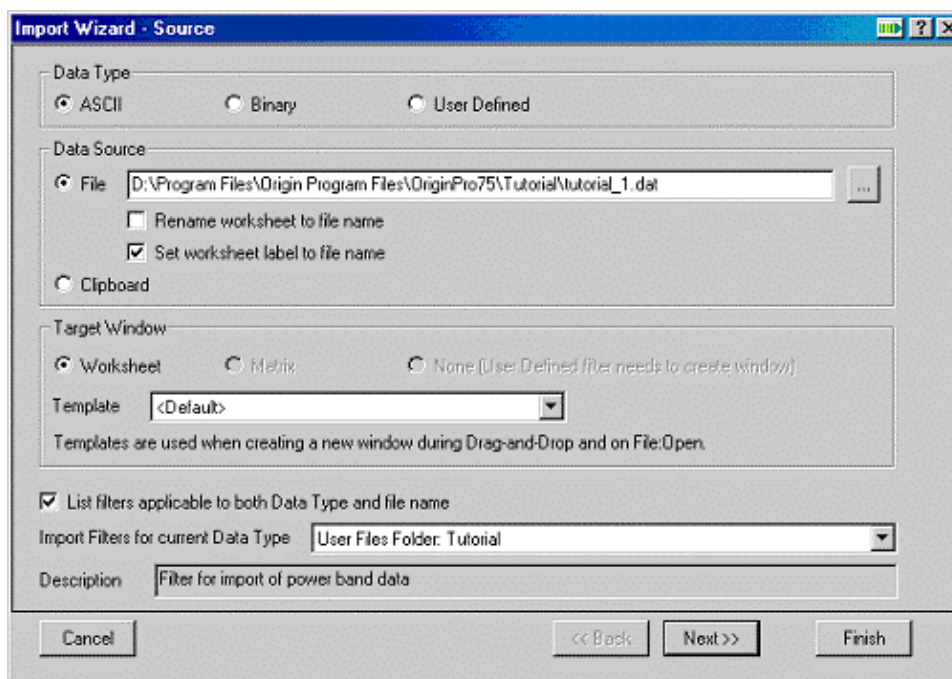
The wizard supports multiple file import. In such cases, it is assumed that all files are of the same file type and format. The first-imported file determines which custom settings or filter will be used to import the remaining files. Each file will be imported into separate target windows. If so specified, the data are simultaneously plotted.

 [See your Origin software to view a multimedia demonstration on this topic \(*Help:Multimedia Demonstrations*\).](#)

Page 1, Data Source

Use the controls on this page to specify a file name, data type, target template and import filter. This page is common to ASCII, binary and user-defined file types. Note that the availability of some controls is dependent upon other settings made on this page. Therefore, it is advised that you proceed systematically through this dialog box, from top to bottom.

The Import Wizard Source Page Dialog Box Controls



Data Type Group

Select one of the following:

- **ASCII.**
- **Binary.**
- **User Defined.** User Defined files require that you supply Origin C code for performing the data import.

Data Source Group

To import data from an **ASCII**, **Binary**, or **User Defined** file type, select the **File** radio button.

Enter the file name of (or use the browse button  to locate) the data file.

- Check **Rename Worksheet to File Name** to rename the worksheet with the file name.
- Check **Worksheet Label to File Name** to label the worksheet with the file name.

To import **ASCII** or **User-Defined** (not Binary) data from the Clipboard, select the **Clipboard** radio button.

Note: There are some restrictions on the naming of Origin worksheets. Illegal characters will result in truncation or modification of file names when naming worksheets. Be sure to read this note on permissible worksheet names and labels on page 3.

Target Window Group

Specify a Target Window -- **Worksheet**, **Matrix**, or **None** -- for the data import.

Name the **Template** to be used in creating new (additional) target windows. New target windows are required for:

- drag-and-drop operations.
- when using the **File:Open** menu command to open data files.
- when using the Wizard to import multiple files.

If *no* template is specified, the Origin default worksheet or matrix template is used.

If a filter exists for the named file type and the filter has a template specification, then the new window is created using the template specified in the **Import Filters for Current Data Type** drop-down list (see next).

List Filters Applicable to Both Data Type and File Name Check Box

If this checkbox is cleared, all filters that are applicable to **Data Type** are displayed in the **Filters** drop-down list.

If this checkbox is selected, the **Filters** drop-down list will display only those filters that also match the name of the file being imported (wild card specification inside the filter should match the file name).

Import Filters for Current Data Type Drop-Down List

The **Import Filters for Current Data Type** drop-down list shows all the filter (.OIF) files that are in:

- the same subfolder as the data file. These filter names are prefixed with the “Data Folder:” tag.
- the \Filters subfolder of the User Files path. These names are prefixed with the “User Files Folder:” tag.
- the \Filters subfolder under the Origin installation directory. These names are prefixed with the “Origin Folder:” tag.

The Description Text Box (non-editable)

This non-editable text box lists any descriptive text that was entered on the last page of the **Save Filters** page of the Import Wizard, at the time of filter (.OIF) creation.

Note: The information provided on this page may be sufficient to complete your data import (in which case, you would click the **Finish** button when you have selected your page options). If you wish to (a) further customize the import options, (b) define and save a new import filter file, or (c) edit the settings in the chosen filter file, click **Next**.

For an overview of Import Wizard features, see *The Import Wizard* on page 86.

To proceed to the next page in the Import Wizard dialog box, go to this page:

- For ASCII files, go to *Page 2, (ASCII) Header Lines* on page 89.
- For Binary files, go to *Page 2, (Binary) Header Bytes* on page 90.

- For User Defined file types, go to *Page 2, (User Defined) User Defined Filters* on page 92.

Page 2

Page 2, (ASCII) Header Lines

Import Wizard Header Lines (ASCII) Dialog Box Controls

Import Wizard - Header Lines

Number of header lines: 8

Save header lines: from 1 to 8

Column names from line: 7

Column label lines: from 7 to 8

Number of characters to skip on name and label lines: 0

Preview Font: System

☒ Define header variables (save into worksheet as info variables)

Measurement Title: Response of the Human Ear to Low Frequency Stimulat
 Measurement Type: Endocochlear Potential and Pressure at 2 Hz
 Acquisition date: 06/23/2003 12:03:51 PM
 Sequence Number: EPP_02_0623

Time ST Potential ST Pressure SU Potential SU Pressure
 sec mv mm Hg mv mm Hg
 0 72.606 0 82.673 0
 0.01 72.355 0 82.673 0.2464
 0.02 71.917 -0.08764 82.735 0.0896
 0.03 71.855 0.03528 82.735 0.2296
 0.04 71.855 -0.15764 82.735 0.0896
 0.05 72.293 -0.07 82.735 0.1764
 0.06 72.202 0.01764 82.735 0.0896

Cancel << Back Next >> Finish

The Number of Header Lines Combo Box

Origin tries to determine the number of header lines in your file and it pre-fills this box. If the number is not correct (as indicated in the preview window at the bottom of the page), you can:

- Type in the correct number.
- Pick the number from the drop-down list (list is limited to 0 - 10).
- Specify this number graphically.

To specify graphically:

- Point to the preview window and click on the last header line of your file.
- Click the **Refresh** button to the right of the **Number of Header Lines** box.

The designated header lines appear in **blue** in the header window.


The Column Names From Line Combo Box

Origin looks for a line that appears to contain column names and identifies the column in the associated box (requires consistent use of a tab or comma delimiter). You can overwrite values by:

- Typing a new row number.

- Selecting a number from the drop-down list.
- Graphically specifying the row number.

To specify graphically:

1. Place your cursor anywhere on the specific line in the preview.
2. Click the **Refresh** button  to the right of the control.

The designated column name line appears in **red** in the preview window.

The Number of Characters to Skip on Name and Label Lines Combo Box

Specify the number of leading characters to skip.

The Preview Font List Box

Choose from **OEM**, **ANSI** or **System** fonts for the Preview window.

The Save Header Lines: From and To: Combo Boxes

These controls specify which header lines should be saved to the worksheet storage object. The default is All header lines. Edit the **From** and **To** values by typing or selecting from the associated drop-down lists.

The saved lines can be retrieved later, from the information stored with the page.


The Column Label Lines: From and To Combo Boxes

Origin tries to determine which line(s) to use for column labels. Typically, this includes all lines starting with (and including) the line used for the column name and ends with the last header line before the first data line.

You can overwrite values by:

- Typing a new row number.
- Selecting a number from the drop-down list.
- Graphically specifying the row number.

To specify graphically:

1. Select one or more lines in the preview window and click the **Refresh** button  to the right of the control.
2. The column name line is colored **green** in the preview window.

The Define Header Variables Check Box

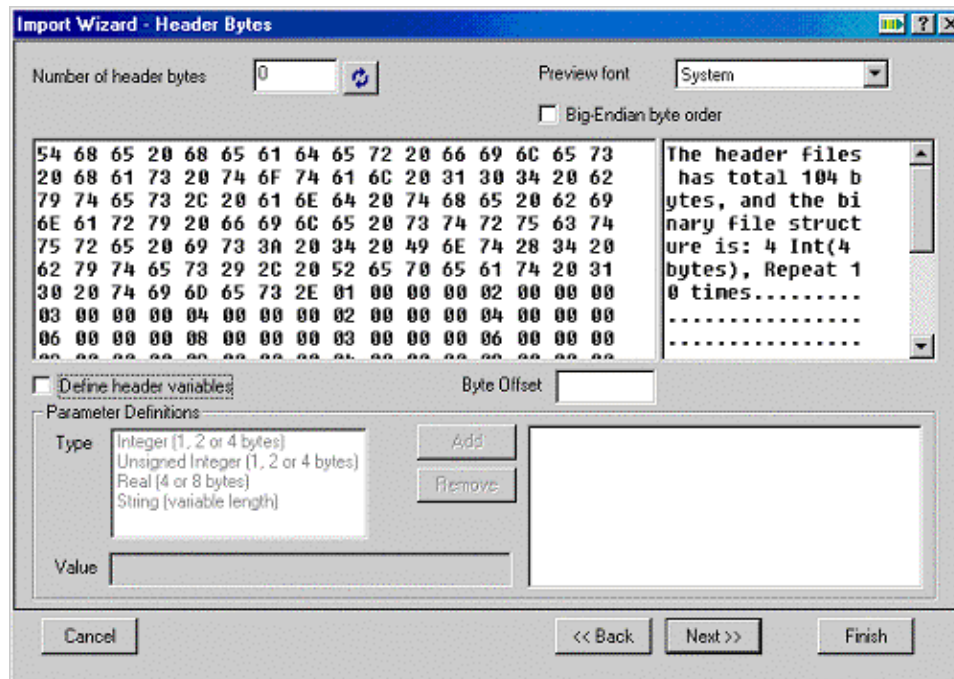
If this check-box is selected, a separate page becomes available upon clicking **Next**. On this page you can specify that variables be extracted from the header lines of your data file.

For an overview of Import Wizard features see page 86.

Page 2, (Binary) Header Bytes


Use this page to define the binary file header and to extract variables from the header for later use.

The Import Wizard (Binary) Header Bytes Dialog Box Controls



The Number of Header Bytes Combo Box

Specify the number of bytes in the binary file header section by typing in a number or select the header section graphically. To select graphically:

1. Place the cursor at the desired location in either the left window (displays the header in byte form), or the right pane (displays the header in ASCII form).
2. Click the refresh button  to the right of the text box.

In subsequent pages, the header is excluded from the data file display and the binary data import will ignore these header bytes.

The Preview Font Drop-Down List

Choose from **OEM**, **ANSI** or **System** fonts for the Preview window.

The Big Endian Byte Order Check Box

This check box sets the byte order of the import data. The *default is Little-Endian*.

The "Little-Endian" terminology refers to a data storage method in which the least significant byte appears first in the number. This format is commonly used by Intel-compatible CPUs; also known as "reverse byte ordering" (Microsoft Computer Dictionary. 1999. Microsoft Press).

The Define Header Variables Check Box:

Select this box to define and extract variables from the header section of the file. Selecting the box enables other page controls used in defining of variables.

The Byte Offset Text Box:

Enter a variable's byte offset (in the header section) in this text box. The hex and ASCII data file displays update to reflect the offset.

You can graphically specify the byte offset by clicking in the hex or ASCII data file views. The text box is updated with the byte offset value.

The Parameter Definitions Group

Once you specify the byte offset:

1. Highlight the bytes in the display that correspond to your variable.
2. Select a variable type from the **Type** list. The value of the variable is displayed in the non-editable **Value** view box, below.
3. Click **Add** to add a variable to the list of variables (the list box to the lower-right) to be stored in the target page.
4. To remove a variable, select the variable in the box to the right and click **Remove**.

Variable definitions can be saved to a filter file for future use with the same or similar files.

Variable values are placed into the page's information storage object on import, and can be retrieved for later use. After import, variable values can be viewed in the script window by making the target page active and typing the command:

Page.info.=

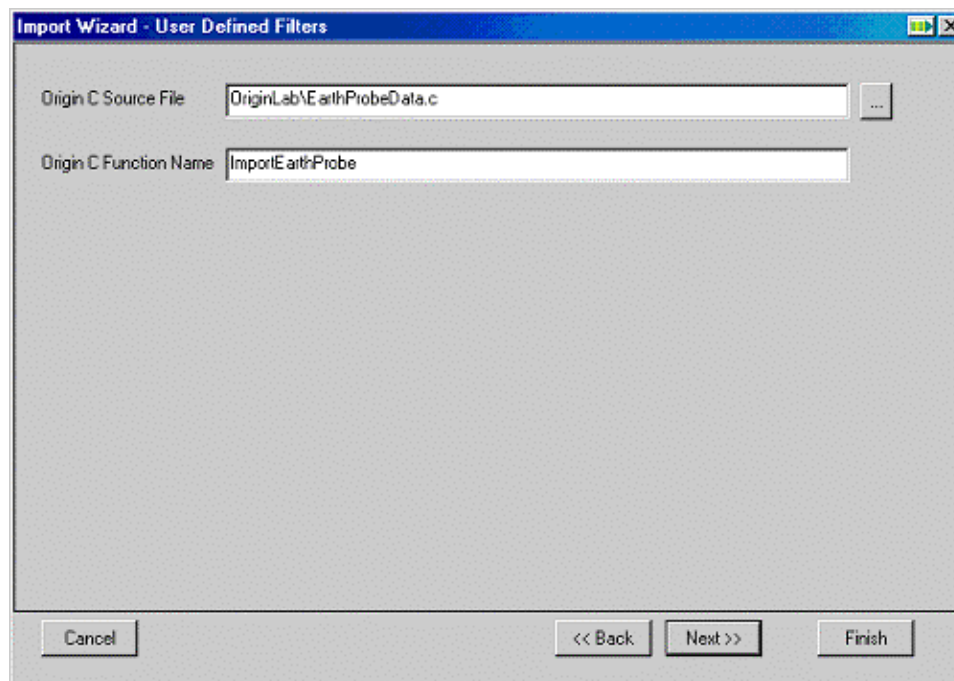
Variable values can be inserted as strings into text labels using the **Insert Info Variables** dialog box. The variable values can also be used in LabTalk and Origin C code.

For an overview of Import Wizard features see page 86.

Page 2, (User Defined) User Defined Filters

Use this page to specify your custom Origin C file, and the name of the function within your Origin C file, which will be used during data import.

The Import Wizard (User Defined) User Defined Filters Dialog Box Controls



The Origin C Source File Text Box

Enter the path to the Origin C file.

The default path for the Origin C file is assumed to be under the \OriginC subfolder of your Origin installation folder. For example, if your file is called **MyFunction.c** and it is located in a subfolder called **MyFiles** under the Origin C subfolder, you should enter **MyFiles\MyFunction.c** in the text box.

You could specify an absolute path (such as d:\myfiles\myfunction). However, this is not recommended in cases where you intend to share your custom function and import filter with others.

The Origin C Function Name Text Box

Name the function (in the previously named **Origin C Source File**) to be used in processing/importing your data to the target window.

To save a filter (remembers your C file location and function name, as well as other settings), see *Page 7, Save Filters* on page 103.

To specify file handling (including drag-and-drop) behaviors, see page 105.

Programming Notes:

Your custom Origin C function should have the following prototype:

```
int YourFunctionName(Page& pgTarget, TreeNode& trFilter,
    LPCSTR lpCszFile, int nFile)
```

where:

pgTarget: A reference to a Page object of type worksheet or Matrix. This would be what you defined in your filter or on the 1st page of the wizard, as the target window.

Note1: The target window and template specification on Page 1 is only used when creating new windows (as would be the case when you use **File:Open** or drag-and-drop importing). When choosing **File:Import**, if your active window is of the same type as your target window specification, no new window is created and a reference to the page object for the active window is passed to your function. If the active window *is* of a different type, a new window is created using the specified template, and the page reference to this new window is passed.

trFilter: A reference to a TreeNode object that holds all the filter settings from your filter file, or from your wizard specifications, in a tree structure.

lpCszFile: The full path and name of the file that is being imported.

nFile: The file index number in an ordered sequence of imported files (e.g. If you drag-and-drop *n* files, or try to **Open/Import***n* files, your function gets called *n* times, and **nFile** is the file count for the file being processed.

Note2: For an example that illustrates writing a custom function, refer to the OC file \OriginC\OriginLab\EarthProbe.c. This file is used by Origin for importing Earth Probe data.

For an overview of Import Wizard features see page 86.

Page 3

Page 3, (ASCII) Header Variables

This page is available only if **Define Header Variables** is selected on the **Header Lines** page, *and* there are one or more header lines in your data file. Use this page to specify extraction of variable values -- parameters, date info, etc. -- that may be contained in your file header. The top part of this page gives a preview of the header lines.

The variables generated by the **Scan** are stored in the information storage object of the destination page. These variables are easily inserted into text labels using the **Insert Info Variables** shortcut menu command.

Variables can be viewed from the Script window by typing the command:

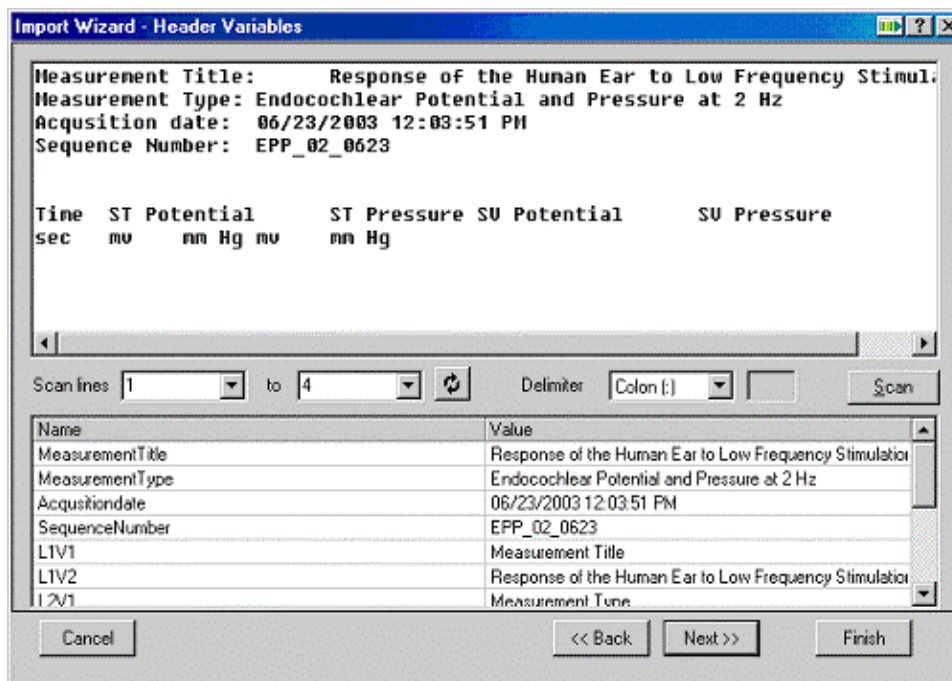
Page.info.user. =

The information storage object of the page also stores information such as name of the imported file, the file path, the filter name (if used), etc.

These are stored under the Page.info.system node of the storage object and are also visible in the **Insert Info Variables** dialog box.

See *Inserting Variables Extracted from Imported ASCII Files into Text Labels* on page 422.

The Import Wizard (ASCII) Header Variables Dialog Box Controls




Scan Lines (From) and To Combo Boxes

Select the range of lines in the header that should be scanned for variables.

Enter values by:

- Typing a new row number.
- Selecting a number from the drop-down list.
- Graphically specifying row numbers.

To specify graphically:

1. Select one or more lines in the preview window and click the **Refresh** button  to the right of the control.

The Delimiter Drop-Down List

Specify the **Names** and **Values** separator in the header lines.

The drop-down lists standard separators such as tab, comma, colon, etc. To use a custom separator, pick **Other** from the drop-down list and specify your custom character in the adjacent text box.

The Scan Button

Scan the specified lines of the header using the specified separator. The results from the scan are entered in the **Name/Value** list.

Scan Procedure Notes:

The scan is performed twice. On the first pass, a search is done for the separator on each line of the header. If the separator is found in a line, all characters to the left of the first occurrence of the separator are assigned to the variable name, and all characters to the right of the first occurrence of the separator are assigned to the value of that variable. Thus, a header line such as:

Acquisition Date: 10th July 2003

will result in a variable named **Acquisition Date** and a value for that variable equal to **10th July 2003**.

The header lines are then scanned a second time. In this second scan, the lines are searched for the separator, and each token found in the line is treated as a separate variable. The variables are then named by the line number and the token position in which they were found. Thus, for the above example, two variables will be found, having these names and values :

L1V1 Acquisition Date

L1V2 10th July 2003

This scan method allows users to extract variables from header lines which are of the form:


Acquisition Date: 10th July 2003

but also from header lines such as:

10, 20, 100, 40, 5

In the latter case, the second scan will extract 5 variables from this line, thus retrieving all values (assuming comma is used as the separator). Note that the dual scan process *can* result in unwanted or unnecessary variables in the list.

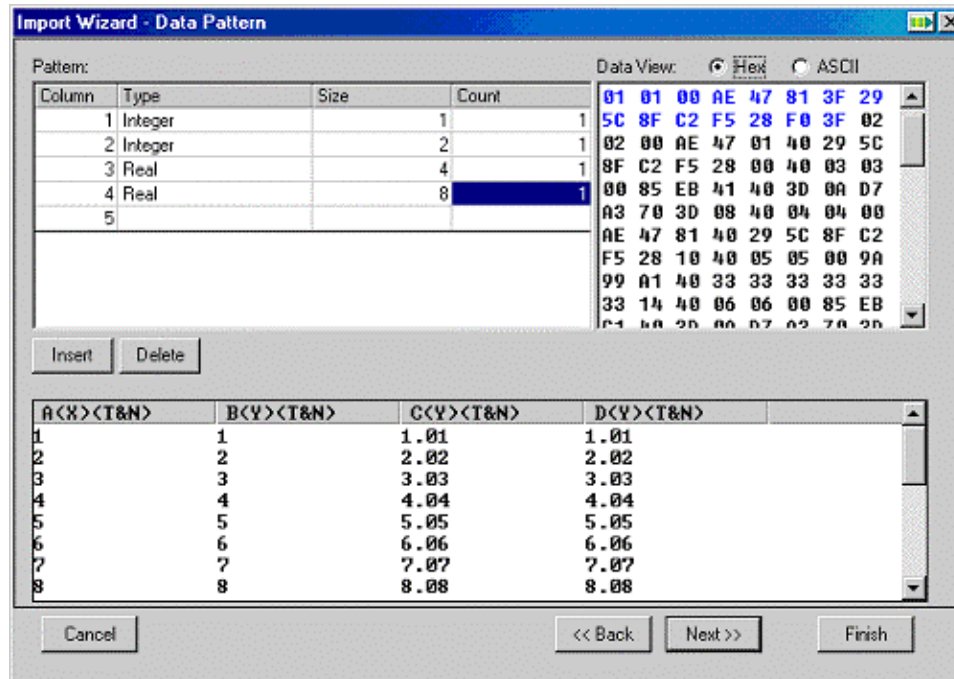
For an overview of Import Wizard features see page 86.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Page 3, (Binary) Data Pattern

On this page, you define the structure of your binary file by specifying the order, type, and datum per record.

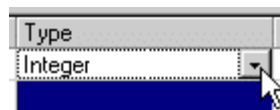
The Import Wizard (Binary) Data Pattern Dialog Box Controls



The Pattern Group

Use this list control to define the structure of the datum in a single record of your binary file.

1. Click to the right side of the **Type** column heading. A drop-down arrow appears.



2. Select a data type from the drop-down list (choices are **Integer**, **Unsigned Integer**, **Real**, and **String**).

Once a data type is chosen, the **Size** column is automatically filled with typical size for that type (except for string, in which case it is left blank). The **Size** column text is editable. For instance, the default length for **int** is 4, but you can replace this with 2 if you want a **short int**. For strings, you should specify the length in characters.

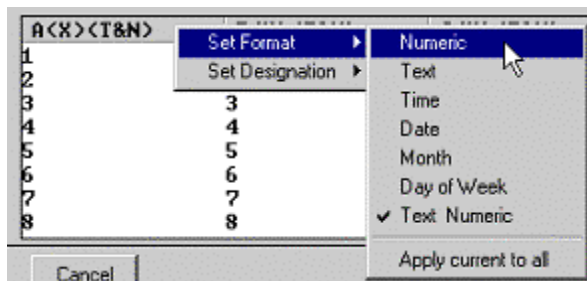
Use the **Count** column to specify the number of times data columns of this variable type are repeated in the record.

Rows are automatically added as you define your data structure. **Insert** or **Delete** rows by clicking the buttons located below this list control.

The Data Display

This panel (viewable as **ASCII** or **Hex**) displays the data, starting from the 1st byte after the header section. Any time a datum is defined, the bytes/characters corresponding to this definition are marked in blue, allowing you to monitor your progress in defining the structure for your record.

When a (row of) structure definition is complete, the bottom panel displays the imported data as it will look in the resulting worksheet, based on the structure of the record specified thus far. Note that you can right-click on the column headers in the bottom panel to set the **Plot Designation** and **Format** for the columns in the target worksheet.

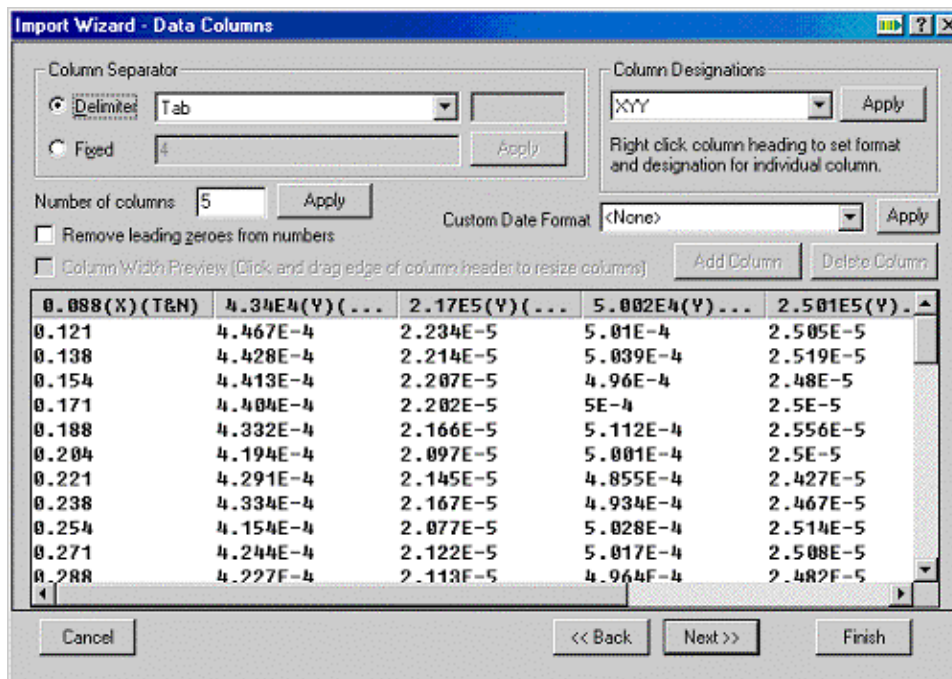


For an overview of Import Wizard features see page 86.

Page 4, (ASCII) Data Columns

Use this page to specify the data delimiter and other settings such as column designations.

The Import Wizard (ASCII) Data Columns Dialog Box Controls



The Column Separator Group

The **Delimiter** Radio Button/Drop Down List/Text Box

Origin scans the data file to determine the delimiter for the data in the file. This control is then pre-filled with the delimiter that was found.

Select a different delimiter from the adjacent drop-down list.

To specify a custom delimiter, choose **Other**, then enter the delimiting character in the adjacent text box. The display in the lower half of this page updates on changing the delimiter. This part of the page displays the data as it would be imported into various columns of the worksheet.

The **Fixed** Radio Button and Text Box

Select this radio button for files that have *fixed width* settings (the column is *n* characters wide, and *n* can vary by column). If you know the column widths, you can enter them in the adjacent text box as a comma separated list (for example, if your file has three columns of width 10, 5 and 7, you would enter "10,5,7" in the edit box and then click the **Refresh** button to see the result below.). If there are more columns in the file than you have listed column widths for, the specified pattern is repeated for the remaining columns.

When **Fixed** is selected, the **Column Width Preview** check box becomes available. See below for information on this control.

The **Number of Columns** Text Box and **Apply** Button

Specify the number of columns to be created in the target worksheet (for the imported data).

- If **Delimiter** was chosen, Number of Columns is pre-filled with the value that Origin determines, using the delimiter specification.
- If **Fixed Width** is chosen, Number of Columns is calculated using the fixed width string.

You can override this value by entering a value and clicking **Apply**. If the value entered is greater than the number of columns in the fixed width string, the last width specified in the string is repeated. The bottom display panel is updated to display the entered (overriding) value when you click **Apply**.

The **Remove Leading Zeros from Numbers** Check Box

Remove leading zeros from imported data (e.g. 0050 becomes 50).

The **Column Width Preview** Window

This option becomes available when **Column Separator** is set to **Fixed**. Use these controls to specify the column width pattern in a fixed width (*non-delimited*) data file.

When selected, the display changes to the **Column Width Preview** mode. In this mode, the columns in the display can be dragged to adjust column width.

☒ Column Width Preview (Click and drag edge of column header to resize columns)

10	10	10
1211.11	212.1	33333.111
111.2	23222.222	313.2
131.333	2222.33	313.3
1211.44	212.4	343333.4444
1211.55	23222.555	3233.55
13111.6662222.66		313.6
111.7	23222.777	33333.777

Columns can be added or deleted using the **Add Column** and **Delete Column** buttons adjacent to this control.

As you drag and changes individual column widths, the text box next to the **Fixed** radio control updates and shows the column widths as a comma separated list. Once the column widths are set, clear this checkbox to view the data columns as they will appear in the target worksheet.

☐ Column Width Preview (Click and drag edge of column header to resize columns)

A(X)<T&N>	B(Y)<T&N>	C(Y)<T&N>
1211.112	12.13	3333.111
111.22	3222.2223	13.2
131.3332	222.333	13.3
1211.442	12.43	43333.4444
1211.552	3222.5553	233.55
13111.6662	222.663	13.6
111.72	3222.7773	3333.777

The Custom Date Format Combo Box

Select a custom date format from the drop-down list.

Alternately, you can type in a custom format using the syntax outlined in the **Custom Date Formats**.

For example, to specify the following date format:

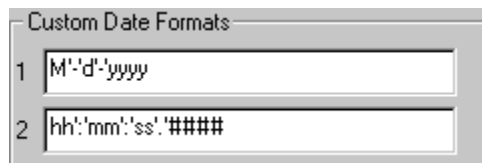
Saturday, September 5, 1998.

Enter:

Custom Date Format:

Two important things to note:

- The options in this list are fixed; they do *not* incorporate custom date formats defined in the **Custom Date Formats** group on the **Miscellaneous** tab of the **Options** dialog box.



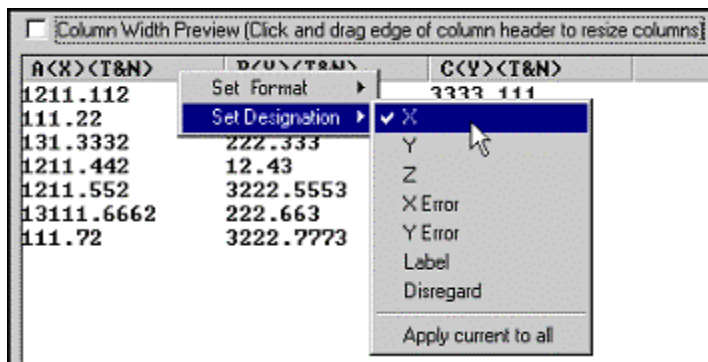
To learn more about the Custom Date Formats group, see the discussion of the **(Options) Miscellaneous** tab on page 661.

- If you type a custom date format into this box, it will not be "remembered" by the Import Wizard (i.e. it is not added to this drop-down list). However, you can *save* your custom date format by saving it with an import filter (.OIF) file.

The Column Designations Drop-Down List

This control can be used to set plot designations for all data columns. Make a selection from the drop-down list, then click the **Apply** button to apply the selected pattern to the columns in the data file. For example, if you choose **XYXY**, the plot designations of the columns will be set to the repeating pattern of "XYXYXY...".

Note that you can also set column format and column plot designations for individual columns by right-clicking on a column heading and choosing **Set Format** or **Set Designation** from the context menu. The **Format** and **Plot Designation** settings will be applied to the target worksheet columns on data import.



For an overview of Import Wizard features see page 86.

Page 5, Data Selection

Use this page to specify a partial file import, and other data handling instructions.

The Import Wizard Data Selection Dialog Box Controls

A(X)<T&N>	B(Y)<T&N>	C(Y)<T&N>
1211.112	12.13	3333.111
111.22	3222.2223	13.2
131.3332	222.333	13.3
1211.442	12.43	43333.4444
1211.552	3222.5553	233.55
13111.6662	222.663	13.6
111.72	3222.7773	3333.777

The Partial Import Check Boxes and From and To Column and From and To Row Text Boxes.

Select this check box to enable the **From** and **ToColumn** and **From** and **ToRow** ranges, for partial import. The default **From** and **To** settings are **1** and **0**, respectively (which will result in *all* columns and rows being imported).

The Non-Numeric Data in a Numeric Field Drop-Down List (ASCII)

If non-numeric data is interspersed with numeric data, you can use this control to decide what action should be taken when non-numeric data are encountered (typically, such non-numeric data is used to identify and separate various datasets in a file).

This drop-down has four options:

- **Terminate Import.** Import will be terminated when the first non-numeric data item is found within the data.
- **Read as Text.** Non-numeric data will be read in as text. If the column **Format** is set to **Text & Numeric**, the text will be visible in the resulting worksheet page.
If the column **Format** is set to **Numeric**, the text will display as missing values.
- **Start New worksheet.** A new worksheet is started if non-numeric data are encountered.
- **Start new Column.** A new column is started in the same worksheet.

The Import Mode Drop-Down List

Determines how the imported data will be treated in the destination worksheet:

- **Replace Existing Data.** Imported data replace existing data in the worksheet. This is the default behavior.
- **Start New Columns.** New columns are added, as needed, to the existing worksheet
- **Start New Rows.** New rows are appended, as needed, to the existing worksheet

Note that use of this setting results in the column **Plot Designation** and **Format** settings of the target worksheet to be changed to the settings assigned to columns in the wizard.

Note: **Start New Columns** and **Start New Rows** are not available when the **Non-numeric Data in Numeric Field...** control is set to **Start New Worksheet** or **Start New Columns**.

The Skip Data and Read Rows Text Boxes

These settings control the which data lines to import.

The default **Skip Data Rows** = **0**. Skip rows must be an integer value greater than or equal to 0.

Read Rows must be an integer value greater than or equal to 1.

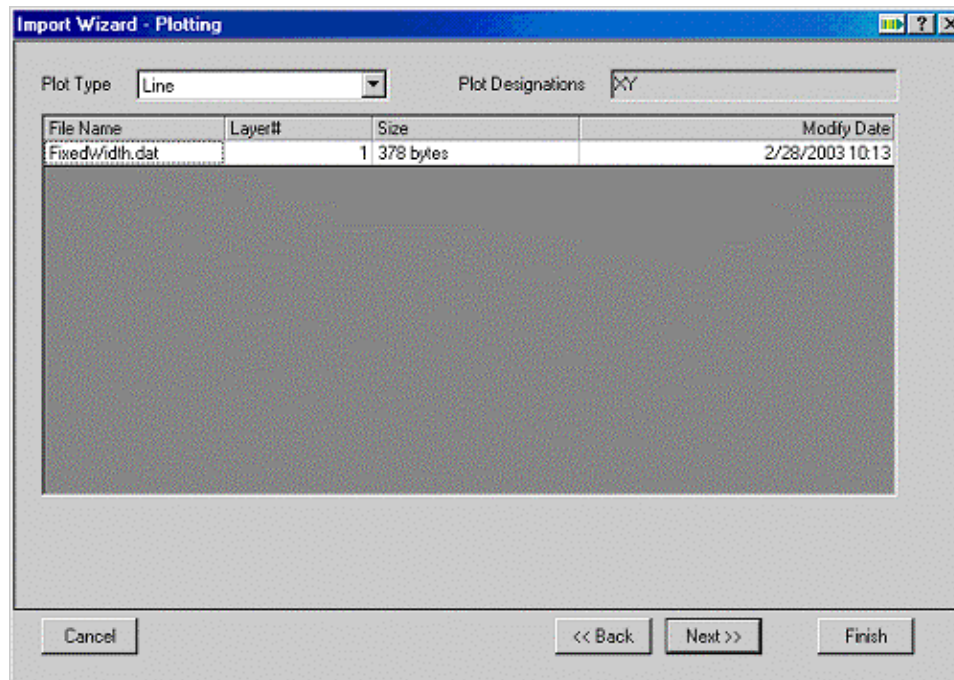
- If **Skip Data Rows** = **0**, no rows are skipped on import. **Read Rows** is ignored.
- If **Skip Data Rows** > **0**, then import **Read Rows** and skip **Skip Data Rows**. This is repeated until the end of file or **Partial Import** range settings are satisfied.

For an overview of Import Wizard features see page 86.

Page 6, Plotting

This page is visible only when a graph page was active when the import wizard was initiated. Imported data are placed into a new worksheet, and the data are simultaneously plotted as per the specifications on this page.

The Import Wizard Plotting Dialog Box Controls



The Plot Type Drop-Down List:

Choose from **line**, **scatter**, **column**, or **bar**.

The Plot Designations View Box:

This non-editable text box displays the column type designations (e.g. XYYYYY), set in the previous Wizard pages.

The List Control:

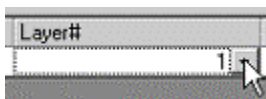
- **File Name:** Name of the import file. If multiple files were selected, all files are listed.
- **Layer#:** This drop-down list shows all the layers available in the graph. Use this to control the graph layer to which each file is imported. All data sets (columns) in the file are plotted in the specified layer. Note that this setting is *not* saved with the OIF file.

To activate the **Layer#** drop-down list:

1. Point to the right edge of the (Layer) *n* list member.



2. Click once; a drop-down arrow appears.



3. Click on the drop-down arrow to see a list of the active graph window's layers. Choose the target layer.



- **Size:** Size of the imported file.
- **Modified Date:** Date of last file modification.

Note: This list can be sorted on any column, providing you control over the order of file import and plotting.

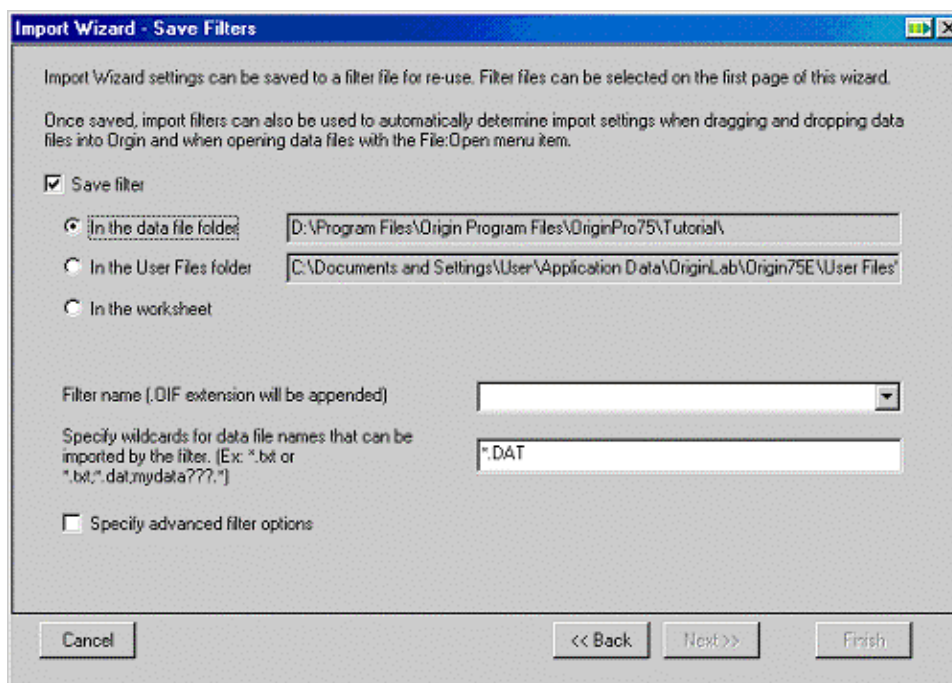
Note: The settings on this page are *NOT* saved with the Import Filter (OIF) file.

For an overview of Import Wizard features see page 86.

Page 7, Save Filters

Import Wizard settings can be saved to a filter file for future use with the same file or with files of the same type. Use this page to save a filter, if so desired. The filter file can be saved to multiple locations. You can specify wild cards for data file names.

The Import Wizard Save Filters Dialog Box Controls



The Save Filter Check Box

Select this box to save Wizard settings to a filter file.

- **In the Data File Folder:** When selected, the filter file is saved in the same folder where the imported data file is saved.

Use this option if you keep similar data files in your folders; you can define a filter that can apply to all files in your folder. When the wizard is used to import the same file or similar files from the same subfolder, the wizard will give preferentially choose matching filter files in the data folder.

Additionally, during drag-and-drop importing Origin will automatically use suitable filters found in the same folder as the data file. If the data folder has multiple filters that are suitable for the file being dropped, Origin will prompt you for the preferred filter file.

- **In the User Files Folder:** If selected, the filter file is saved to the \Filters subfolder in the User Files area. The **File Types** drop-down in the **File:Open** dialog will list the filter by name, along with the chosen wild card specification. This option provides the user with a way to add custom file types to the **File:Open** dialog.
- **In the Worksheet:** If selected, the filter is saved to the worksheet. You then save the worksheet as a template (*.OTW) and the filter information becomes part of the template. If the worksheet has a filter saved in it, when the import wizard is invoked with such a worksheet active, the Filter drop-down on the first page will list the option "<User filter in active window>".

The Filter Name Text Box

Name the filter file (the .OIF extension is automatically appended).

This control is not available when the **In the Worksheet** option is chosen. In the other two cases (where the filter is saved to a disk file), the filter files are saved with an OIF (Origin Import Filter)

extension, in the XML format. The files are editable with a text editor such as Notepad and can be viewed with any application that supports the XML format (such as Internet Explorer).

The Specify Wildcards... Text Box

Use this box to specify wildcards for data files to which the saved filter should be applied.

Examples:


- Specify a wildcard such as *.txt, in which case any file of extension .txt will be associated with this filter.
- Specify wildcards such as Experiment*.t*, in which case files with such names as Experiment1.txt, Experiment2.txt, etc., would be associated with this filter.
- Specify multiple wildcards using a semicolon separator: *.txt;*.dat;mydata*.*, etc. When you choose to import a file using the Wizard (by any method including drag and drop), wildcards in all filters saved to the various locations are scanned to find those filters that match the name of the import file.

The Specify Advanced Filter Options Check Box

If selected, the **Next** button (at the bottom of the page) is enabled and another Wizard page is added in which you specify advanced filter options, such as a script to be executed at the end of the import process, etc.

If left cleared, the **Next** button is *disabled*. You then click **Finish** to complete data import.

For an overview of Import Wizard features see 86.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Page 8, Advanced Options

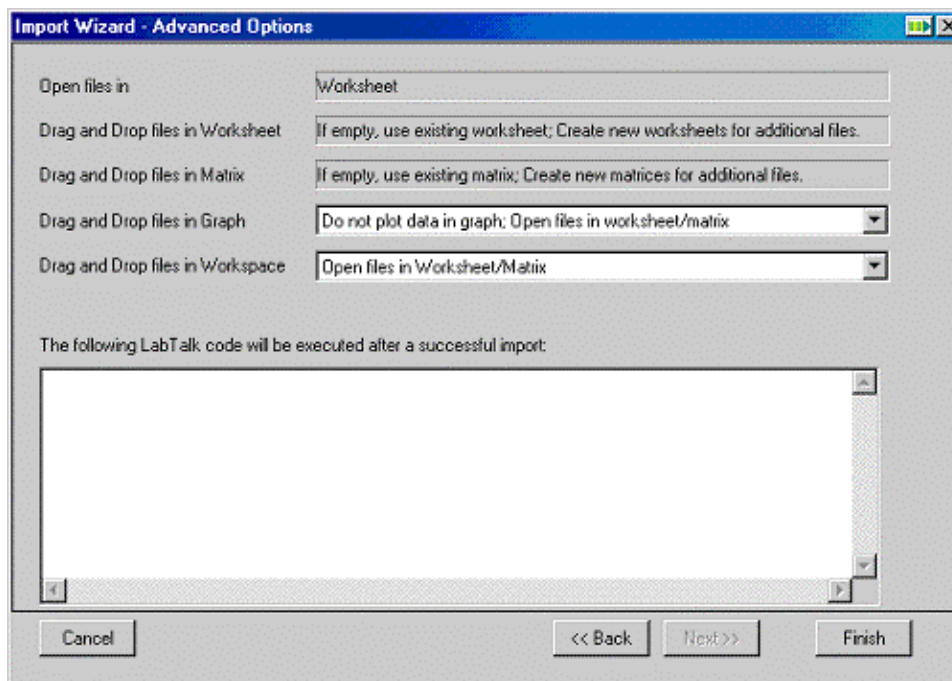
This page is only visible when you select the **Specify Advanced Filter Options** check box on the **Save Filters** page of the Import Wizard.

Use this page to:

- Specify the action Origin should take when you are importing file by drag-and-drop.
- Specify LabTalk script that should be run at the end of the import process.

The first three view boxes on this page preset and non-editable. Settings in the next two drop-down lists determine what action to take when files are dropped onto a graph or onto the Origin workspace (outside of any window).

The Import Wizard Advanced Options Dialog Box Controls



The Drag and Drop Files in Graph Drop Down List

- **Do Not Plot in Graph; Open Files in Worksheet/Matrix** (default): The data are imported into a worksheet or matrix (whichever is specified on the Wizard's **Data Source** page). No plot is made.
- **Plot Data into Graph Layer into which Files are Dropped:** All imported data columns are plotted to the layer onto which files were dropped (see, *The Layer* on page 137).
- **Plot Data in Graph Using Layers Specified on Plotting Page:** This option is available only when the active window is a graph window. This uses the specifications of the optional Plotting page. Note that the settings on the Plotting page are *not* saved with the OIF file.

The Drag and Drop files in Workspace Drop Down List

- **Open Files in Worksheet/Matrix** (no plots are made).
- **Plot Data in Graph with All Files in One Layer.**
- **Plot Data in Multi-panel Graph with Each File in One Panel.**
- **Plot Data in Multiple Graph Windows with Each File in One Graph.**

The LabTalk Code Window:

Type or copy LabTalk code that you want to execute at the end of the import process, in this text box. The code is saved with the OIF and will execute any time the import filter is used. This provides an easy way to automatically post-process data at the end of the import process.

Example 1: You wish to swap columns 1 and 2 after importing the data. To do this, you would enter the following script:

```
temp=col(1);
col(1)=col(2);
col(2)=temp;
del temp;
```

Example 2: You wish to add column 2 to column 1, then delete column 2. To do this, you could enter the following script:

```
col(1)+=col(2);
del col(2);
```

Note that you can also call Origin C functions to perform post-processing, provided those functions are already compiled and included in your workspace. For more information on calling Origin C functions from script, please refer to the topic *Calling Origin C Functions from LabTalk*, in the Programming Help File (**Help:Programming**).

For an overview of Import Wizard features see 86.

Importing Data from a Database Using ODBC

ODBC Terminology

Database: The term database refers to a 'DataBase Management System' (DBMS) such as Microsoft Access. A DBMS provides an efficient way to store and access data.

Data source: The term data source refers to a particular set of data stored and managed by a particular DBMS. For example, you might have one data source named *Exp1* saved in the Microsoft Access database, and another data source named *Proj1* stored in yet another database.

Tables and Views: A data source consists of tables of data. These tables can be joined using SQL commands to form views. Views are virtual tables that don't take up additional space beyond their component tables and the SQL command that joins them together. For example, a table consisting of names and zip codes can be joined to a table consisting of zip codes and city/state information to form a 'view' of name, city, state, and zip code.

SQL: SQL stands for Structured Query Language. SQL is a standardized language that has evolved for accessing data from a variety of databases. SQL can be used to select particular data from your data source. The result of an SQL 'query' can be saved as a view, or read into another application for examination.

ODBC: ODBC stands for Open Data Base Connectivity. ODBC is a library of functions that provides a common interface for a variety of database systems.

ODBC Driver: Database manufacturers create ODBC drivers that interpret the common ODBC interface functions into a form understandable to their particular database system. In this way, an application such as Origin can use a single common ODBC interface to access a variety of databases, provided they have an ODBC driver.

Origin's ODBC Feature

Origin's ODBC feature allows you to select a data source from any database for which an ODBC driver is installed, including Microsoft Access and Excel, dBASE, FoxPro, and Paradox. Once you have selected your database, you can then select a table or a view from the desired data source. Select all or part of the data source table or view for import into your Origin worksheet.

Origin also provides a DLL (Dynamic Link Library of functions) that can be used to form an ODBC command object. The properties and methods of this command object connect Origin to Microsoft's ODBC interface. This interface is a library of functions that allows you to specify a data source, execute SQL (Structured Query Language) queries and retrieve data. An ODBC database driver interprets and implements the ODBC interface function calls for its associated database, taking care of the particulars of that database. Origin can thus access a data source from any database for which there is an ODBC driver.

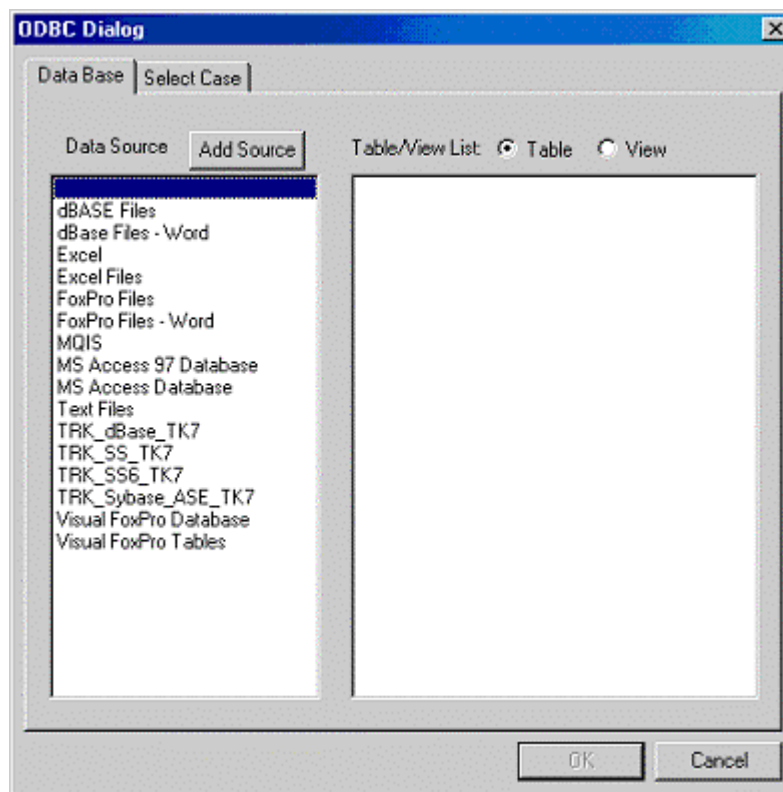
Importing a Data Source Table into Origin

To open the **ODBC Dialog** dialog box:

1. Activate the worksheet and select **File:Import:ODBC**.

The ODBC Dialog Data Base Tab Controls

Edit this tab to add or delete data sources, and to select data sources and tables and views.

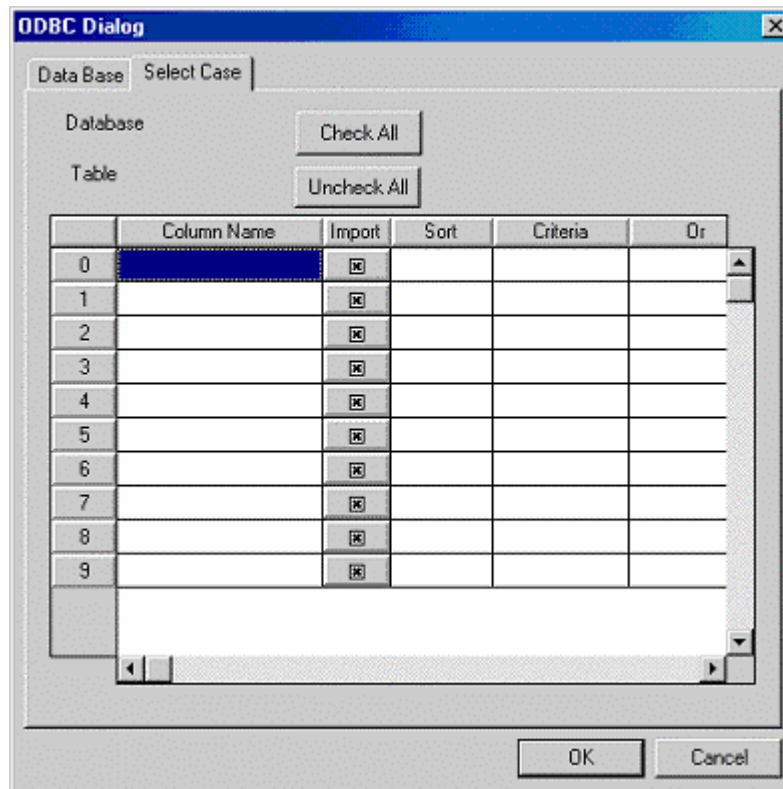


The **Data Source** list displays any data source that you currently have access to. These names are user-defined and are not necessarily the same as the file name containing the data source.

The **Table/View** List displays the tables/views associated with the selected data source.

The **Add Source** button connects you to Microsoft's ODBC Data Source Administrator dialog box, which allows you to add a new data source, find the full path name of any data source already listed, delete an existing data source, and add or delete a database driver. Consult the dialog box's Help file for further instructions.

The ODBC Dialog Select Case Tab Controls



Select this tab to import all or part of the chosen data table or view (selected from the **Data Base** tab) into an Origin worksheet. You can specify the columns you want, sort along any one column, and impose conditions on the data values that you want to import for each column.

The column names for the table/view are listed in the **Column Name** column.

The **Import** check boxes determine which columns you want to read into the current Origin worksheet. Only checked columns are imported. The **Check All** and **Uncheck All** buttons can be used to check or uncheck all of the table/view columns at once.

The **Sort** field allows you to sort the imported data along any one selected column in either ascending or descending alphanumeric order. The Not Sorted drop-down list selection returns the order to the original order of that column in the table/view. You can only sort along one column.

The **Criteria** field allows you to establish conditional relations that can be used to select data from any desired column.

You can use the following relational operators:

Operator	Definition
<	Is less than.
<=	Is less than or equal to.
=	Is equal to. (This differs from the LabTalk equality operator, ==.)
>=	Is greater than or equal to.
>	Is greater than.
<>	Is not equal to. (You cannot use ! or ^ for the logical NOT.)

Note 1: String comparisons are not case sensitive.

Note 2: After you add an entry to the **Criteria** or **Or** field, you can correct the string in the cell by first pressing ESC, and then clicking at the desired position in the string.

The criteria for each column are joined into one condition with the logical **AND** statement. For example, suppose there are columns named State, Sales, and Balance, and you enter the Criteria = "Texas", ≥ 5.0 and < 0 for the three columns respectively. Then you have selected data satisfying the condition:

State="Texas" AND Sales \geq 5.0 AND Balance $<$ 0

You can also include criteria from the Or field for each column of data. These criteria are also joined into one condition by the AND statement. Then the condition under the Criteria field is joined with the condition under the Or field by the logical OR statement. For example, if you have conditions x, y, and z in the Criteria fields, and a, b, and c in the Or fields, then the expression is (a AND b AND c) OR (x AND y AND z).

Click **OK** to have the selected data read into the active worksheet.

Click **Cancel** to do nothing and exit ODBC.

To select all or part of a data source table or view and import the selected data into a worksheet, do the following:

1. Make the desired worksheet active.
2. Select **File:Import:ODBC**. Origin displays the ODBC Dialog dialog box.
3. Select the desired data source from the **Data Source** list box. If the desired data source is not listed, you must first add the data source to the list. Origin responds by listing the available tables and views for that data source in the **Table/View List** list box.
4. Click the desired table or view and then click on the **Select Case** tab.
5. Make your entries under the **Import**, **Sort**, **Criteria** and **Or** fields to select all or part of the data for import into Origin.
6. Click **OK**. Origin imports the selected data into the active worksheet. You can now perform analysis and graphing procedures.

Maintaining the ODBC

Adding Data Sources and Drivers

You can reach Microsoft's ODBC Data Source Administrator dialog box directly from your Windows Control Panel (**Start:Settings:Control Panel**). This dialog box allows you to:

- Add a new data source.
- See the full path name of any data source already listed.
- Delete an existing data source.
- Add or delete a database driver.

Review the Windows Help file for instructions.

To add a data source, you will need to select a driver appropriate to your data source from the list of installed drivers and enter the path and file name of the file which contains the data source. Give the data source a name meaningful to your current application. The new data source will now be listed in the Data Source list in Origin's Data Base tab of the ODBC Dialog dialog box. Origin can then access this new data source.

Troubleshooting Tips

You must install the proper ODBC driver for the database you are using. For example, if your data source is stored in a database version that is newer than the database driver you have on your computer, then you may not be able to access your data source. Additionally, other software that you install may modify your current ODBC files and disrupt function. If you have trouble using ODBC, re-install Microsoft's ODBC files. You can do this by re-installing Microsoft Office (which will include the ODBC interface functions and drivers you need).

Associating LabTalk Scripts with Worksheets

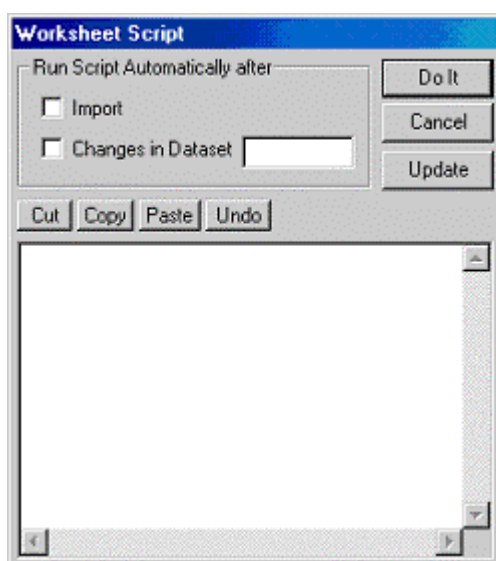
The Worksheet Script Dialog Box

To open the **Worksheet Script** dialog box:

1. Select **Tools:Worksheet Script** when the desired worksheet is active.

The LabTalk script that is entered in this dialog box is associated with the active worksheet. The method of script execution is controlled within the dialog box. Save the worksheet as a template and the associated worksheet script is saved as well.

Worksheet Script Dialog Box Controls



The Run Script Automatically After Group

Import. Select the **Import** check box to execute the worksheet script each time you import ASCII data into the worksheet.

Changes in Dataset. Select the **Changes in Dataset** check box to run the script whenever a change is made through script to the data set specified in the associated text box.

The Script Box

Type the desired LabTalk script in this text box. The script should follow the same syntax conventions as a LabTalk script file. For more information, see the **LabTalk Language Reference Section** of the Programming Help file (**Help:Programming**).

The **Do It** Button

Click this button to immediately execute the script in the script box. Additionally, the script and execution method are set as the default settings for the worksheet.

The **Update** Button

Click this button to set the script and execution method as the default settings for the worksheet.

The Matrix

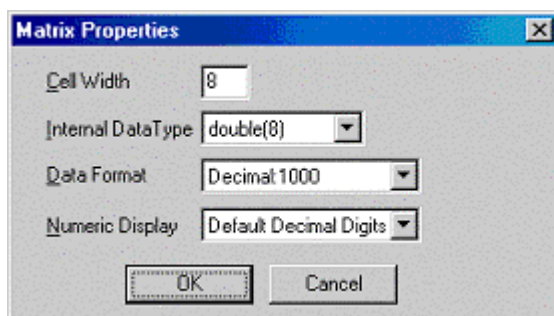
Setting the Matrix Data Properties

The **Matrix Properties** dialog box controls the internal data type, data format, and data display properties of a matrix window. To set these properties:

1. Activate the matrix window and select **Matrix:Set Properties** from the Origin menu.

This opens the **Matrix Properties** dialog box.

Matrix Properties Dialog Box Controls



The Cell Width Text Box

Specify the cell width in units of characters.

The Internal Data Type Drop-down List

Option	Description
Double (default)	allocates eight bytes of storage space to each value. Double is the <i>only</i> data type that supports: <ul style="list-style-type: none">• missing values• math operations• curve fitting
Float	allocates four bytes of storage space per value.
Int*	allocates four bytes of storage space per value.
Short*	allocates two bytes of storage space per value.
Char*	allocates one byte of storage space per value.

*signed or unsigned.

The Data Format Drop-down List

Use the **Data Format** drop-down list to select between the decimal, engineering, and scientific display formats:

Option	Description																																	
Decimal:1000	1, 1000, 1E6, 1E9 The threshold for conversion to scientific notation is controlled on the Numeric Format tab of the Options dialog box (Tools:Options).																																	
Scientific:1E3	1E0, 1E3, 1E6, 1E9																																	
Engineering:1k	1.0, 1.0k, 1.0M, 1.0G <u>Origin supports the following Engineering data suffixes:</u> <table><tr><th>suffix</th><th>equivalent</th><th>quantity</th></tr><tr><td>k</td><td>kilo</td><td>10^3</td></tr><tr><td>M</td><td>mega</td><td>10^6</td></tr><tr><td>G</td><td>giga</td><td>10^9</td></tr><tr><td>T</td><td>tera</td><td>10^12</td></tr><tr><td>P</td><td>peta</td><td>10^15</td></tr><tr><td>m</td><td>milli</td><td>10^-3</td></tr><tr><td>u</td><td>micro</td><td>10^-6</td></tr><tr><td>n</td><td>nano</td><td>10^-9</td></tr><tr><td>p</td><td>pico</td><td>10^-12</td></tr><tr><td>f</td><td>femto</td><td>10^-15</td></tr></table> <p>Note that "u" is Origin's universal notation for micron. The only exception is graph axes tick labels, which support "mu". Note also that Origin 7 does not support "E" and "a" as suffixes.</p>	suffix	equivalent	quantity	k	kilo	10^3	M	mega	10^6	G	giga	10^9	T	tera	10^12	P	peta	10^15	m	milli	10^-3	u	micro	10^-6	n	nano	10^-9	p	pico	10^-12	f	femto	10^-15
suffix	equivalent	quantity																																
k	kilo	10^3																																
M	mega	10^6																																
G	giga	10^9																																
T	tera	10^12																																
P	peta	10^15																																
m	milli	10^-3																																
u	micro	10^-6																																
n	nano	10^-9																																
p	pico	10^-12																																
f	femto	10^-15																																
Decimal:1,000	1, 1,000, 1E6, 1E9 The threshold for conversion to scientific notation is controlled on the Numeric Format tab of the Options dialog box (Tools:Options).																																	

The Numeric Display Drop-down List

Select **Default Decimal Digits** to display all digits in a matrix cell as determined by the Number of Decimal Digits combination box value on the Numeric Format tab of the Options dialog box.

Select **Set Decimal Places** = to control the display of the number of digits after the decimal place (overrides the **Number of Decimal Digits** setting on the **Numeric Format** tab of the **Options** dialog box). Type the desired decimal place value (*n*) in the associated text box. This value determines the maximum number of digits displayed after the decimal point. If the field is blank, the default value is used (which is 5 for Double (8) internal data types).

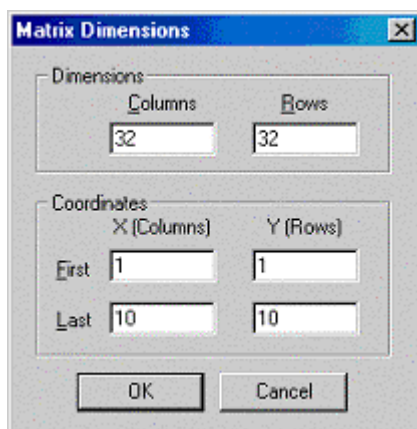
Select **Significant Digits** = to control the number of digits displayed. Type the desired significant digit value in the associated text box.

Setting the Matrix Dimensions and XY Coordinates

To set the matrix dimensions and the XY mapping relationship:

1. From the Origin menu, select **Matrix:Set Dimensions**.
2. This opens the **Matrix Dimensions** dialog box.

Matrix Dimensions Dialog Box Controls



The Dimensions Group

Enter the number of columns (X dimension) and rows (Y dimension) in the associated text boxes.

The Coordinates Group

Type the first and last X and Y values in the associated text boxes.

When you click **OK**, Origin will linearly map the matrix in X by columns using the **First** and **Last** X (Columns) values and the number of **Columns** (the **Dimensions** group). Origin will linearly map the matrix in Y by rows using the **First** and **Last** Y (Rows) values and the number of **Rows** (set in the Dimensions group).

Customizing the Display Properties of a Matrix

To customize the text color, style, and heading and grid options of a matrix:

1. Double-click in the upper-left corner of the matrix window. This opens the **Matrix Display Control** dialog box.

The controls in this dialog box are identical to those found in the **Worksheet Display Control** dialog box. For a complete description of controls, see 42.

Saving a Matrix Window

To save a matrix window with its data:

1. Select **File:Save Window As**.

This menu command opens the **Save As** dialog box. 'Matrix (*.OGM)' is selected (by default) from the **Save as Type** drop-down list.

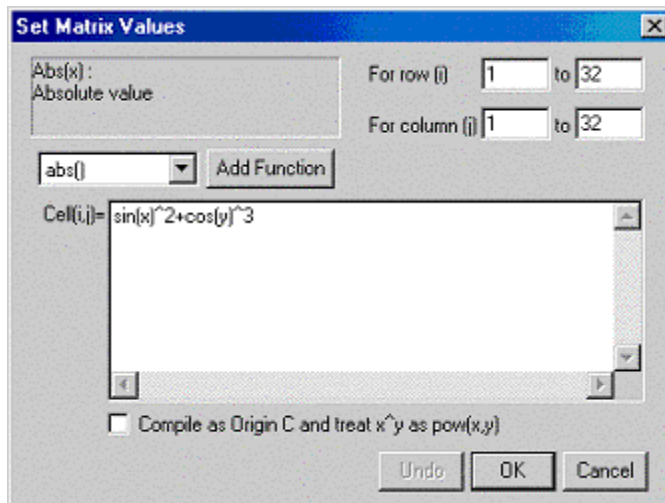
2. Type the desired file name in the **File Name** text box and select the desired destination folder. You do not need to include the file extension in the File Name text box.

Data Input

Setting the Matrix Values

To fill the matrix with Z values, select **Matrix:Set Values**. This menu command opens the **Set Matrix Values** dialog box.

Set Matrix Values Dialog Box Controls



For Row (i) and For Column (j)

Enter the range of column (*j*) and row (*i*) numbers to be filled with data values. Matrix values are only entered in the cells that fall within the selection range.

Add Function

The **Add Function** drop-down list and button are provided to help you build your expression in the **Cell(i,j)=** text box. Instead of typing out the function in the **Cell(i,j)=** text box, you can select a function (or functions) from this list.

The Add Function list includes Origin's built-in mathematical and statistical distribution functions. To view the details of a function, select the function from the drop-down list. A function summary -- including a description of the function arguments -- displays in the upper view box. To select a function so that it displays in the **Cell(i,j)=** text box:

1. Select the function from the list.
2. Click the **Add Function** button.

If text was highlighted in the **Cell(i,j)** text box, that text becomes the (last) argument for the selected function. If no text was highlighted, the function displays at the last active cursor position in the text box.

The Cell(i,j)= Text Box

Enter an expression to fill the **For Row (i)** and **For Column (j)** cells with values. The expression can include any of Origin's built-in functions (the **Add Function** controls provide a convenient method for adding mathematical and statistical distribution functions to the expression). You can use any of Origin's built-in functions following the syntax described in the The LabTalk Language

Reference (**Help:Programming:LabTalk Language Reference**). In addition to functions, you can use any operators recognized by Origin, as well as any defined variables.

You can reference a single cell in a matrix by using this syntax:

$$\text{MatrixName}[N*(i-1)+j]$$

where:

N = the number of columns in the matrix.

i = the row number in the matrix.

j = the column number in the matrix.

Note: Do not include a semicolon after the expression.

The Compile as Origin C and Treat x^y as $\text{pow}(x,y)$ Check Box

You can define and compile an Origin C expression in the Cell(i,j)= text box. Enter an Origin C expression, then select this check box, and click **OK**. Any compiler errors are typed out to the Script window. To learn more about Origin C, see the Programming Guide Help file (**Help:Programming**).

The OK Button

Click to close the dialog box and set the values for the **For Row (i)** and **For Column (j)** cells using the expression in the **Cell(i,j)=** text box.

The Undo/Redo Button

Click to **Undo/Redo** the last change made to the expression in the **Cell(i,j)=** text box.

Viewing the Matrix Values

1. Use the scroll bars on the right and bottom edges of the matrix window to view the desired cells.


or

1. Select **View:Go to Row** to view a specific matrix row. This menu command opens the **Go to Row** dialog box.
2. Type the desired row number in the associated text box.

Import Data into the Matrix

Importing ASCII Data into a Matrix

To import ASCII data into a matrix:


1. From the menu, select **File:Import ASCII** or click the **Import ASCII**  toolbar button. Both actions open the **Import ASCII** dialog box.
2. Select your data file and click **Open** to import the file into the matrix.

The values imported into the matrix are assumed to be Z values. Set the matrix XY mapping relationship in the **Matrix Dimensions** dialog box after reading in the Z data (**Matrix:Set Dimensions**).

Origin's Drag-and-Drop Data File Support for Matrices

You can drag Thermo Galactic SPC data files from Windows Explorer into an Origin matrix.

To do this:

1. Open a fresh matrix window in Origin by clicking the **New Matrix** button  on the Standard toolbar.
2. Select the desired file in Windows Explorer.
3. Drag the file over the Origin taskbar button and hold there until Origin becomes active.
4. Continue dragging the file and drop it into the Origin matrix window.

You can also drag image files into an Origin matrix. To learn more about Origin's support of image data, see *Importing, Plotting, and Analyzing Raster Images* on page 118.

Importing, Plotting, and Analyzing Raster Images

Data Mode and Image Mode

When you import a raster image into a matrix, a cell is created in the matrix for each pixel in the image. The matrix is viewable in two modes:

- As a color or gray-scale device-independent bitmap (DIB).
- As a matrix of data derived by converting the DIB to data values. Origin does this by converting each pixel to an RGB value, then assigning a corresponding index number from a gray scale palette, based on the RGB value of the pixel.

To view a DIB as a matrix of values:

1. Select **View:Data Mode**.

Once you view the matrix in Data Mode, you cannot return to the original DIB view.

To convert back to image view:

1. **View:Image Mode**.

The matrix now displays the image by mapping each cell's index value to a gray scale palette.

Entering Image Data Directly into a Matrix

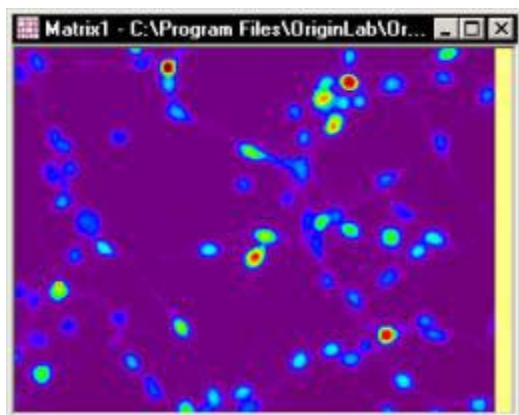
In addition to importing images, you can enter image data directly into a matrix (via keyboard entry, by importing ASCII data, pasting data from the Clipboard, etc.). The values that you enter are considered to be 8-bit or higher gray scale intensity values. Before entering values in a matrix, select **Matrix:Set Properties** to correctly set the internal data type.

When you select **Image Mode** to view the image (**View:Image Mode**), Origin composes the image by converting each intensity value to an index number from a gray scale palette. The gray scale palette depends on the internal data type (resolution) of the matrix. As with imported images, you can change the palette by selecting **Image:Palette:PaletteSelection**.

Color Palettes to Enhance Image Analysis

You can also view the image using a built-in or user supplied color palette. Viewing the image using a specified color palette can increase contrast and emphasize certain regions of the image.

Viewing the Image Using a Built-in Palette for Improved Clarity



To view the image using a color palette, you must first convert the DIB to matrix data:

1. Select **Image:Convert to Gray + Data**.
- or
1. Select **View:Data Mode**, then select **View:Image Mode**.

Origin converts each pixel to an RGB value, then assigns the corresponding matrix cell an index number from a gray scale palette, based on the RGB value of the pixel.

To display the image using a palette other than gray scale:

1. Select **Image:Palette:PaletteSelection**.

A number of built-in palettes are provided. For information on including your own palettes, see *Adding New Color Palettes to Origin* on page 681.


You can adjust the brightness and the contrast of the image using the **Tuning** tool. To open this tool:

1. Select **Image:Tuning**.
 - The **Brightness** slider shifts the range of Z values that are mapped to the palette.
 - The **Contrast** slider broadens or narrows the Z value range that is mapped to the palette.

Adjusting the Brightness and Contrast of the Image



Examining a Region of Interest

If you are only interested in a region of the image, you can select a region of the DIB using the Rectangle Tool in "region of interest mode"  on the Tools toolbar. The "region of interest mode" is controlled from the **Tools:Region of Interest Tools** menu command.

Selecting a Region of Interest

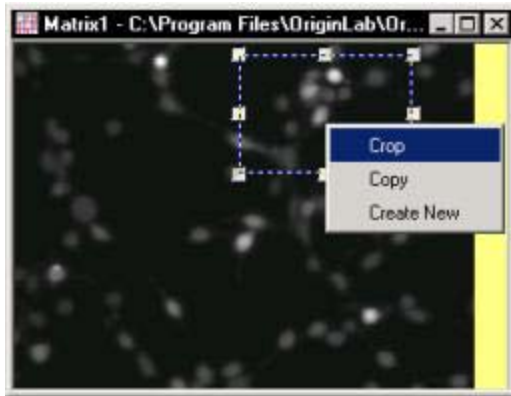


Image Plots

Once you have imported a raster image file into an Origin matrix window, you can create a gray-scale "image plot" of the image.

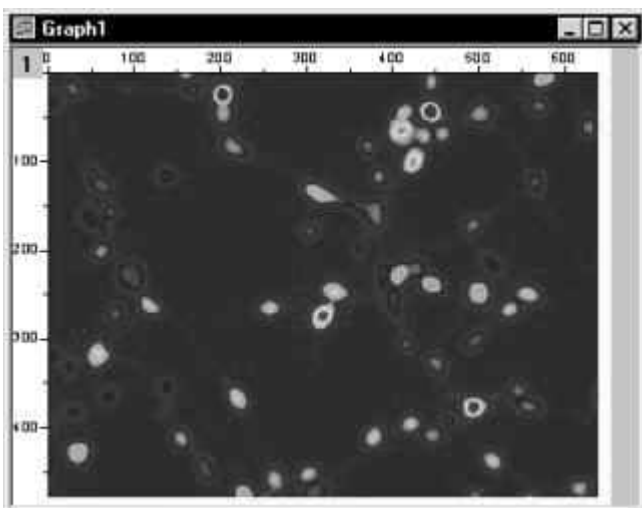
To plot your imported image in an Origin graph window:

1. Select **Plot:Image Plot**.

If the color density of the imported image is greater than 8-bits per pixel, an attention message asks whether you wish to convert the image to 16-bit gray scale plot. Clicking **No** will convert the image to 8-bit gray scale plot.

The default X and Y axis range is determined by the coordinate range of the matrix, which is the same as the image's X and Y pixel range.

Plotting the Image into a Graph



The resulting image plot is similar to an Origin Gray-scale Map contour plot.

- To customize the map contour levels or scale numeric values, double-click on the plot to open the (Plot Details) **Numeric Formats** tab.
- To customize the graph axes, double-click on (any of) the plot's axes to open the **Axis dialog** box.

Image Processing Example

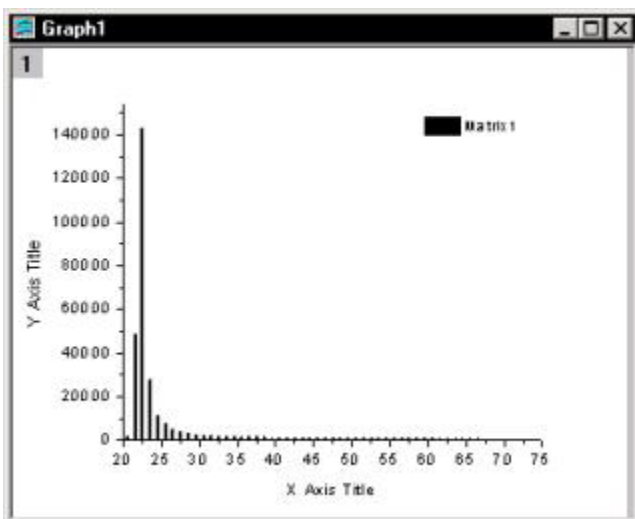
Origin provides a basic image processing example that allows you to choose a filter and then apply the filter to the image. The example uses Origin C code to perform the filter operations.


To review this example, open IMAGE PROCESSING. OPJ located in the Origin \SAMPLES\PROGRAMMING\IMAGE PROCESSING subfolder.

Plotting an Image Histogram

After importing a raster graphic image into a matrix, Origin can create a histogram of the intensity values in the image. To plot a histogram from the image in the matrix, select **Plot:Histogram**.

Example Image Histogram



 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Viewing the Images X and Y Projections

Matrix images can also be plotted using a graph template that includes X and Y projections. To plot to this template, select **Plot:Profiles**.

To manipulate the view of X and Y projections:

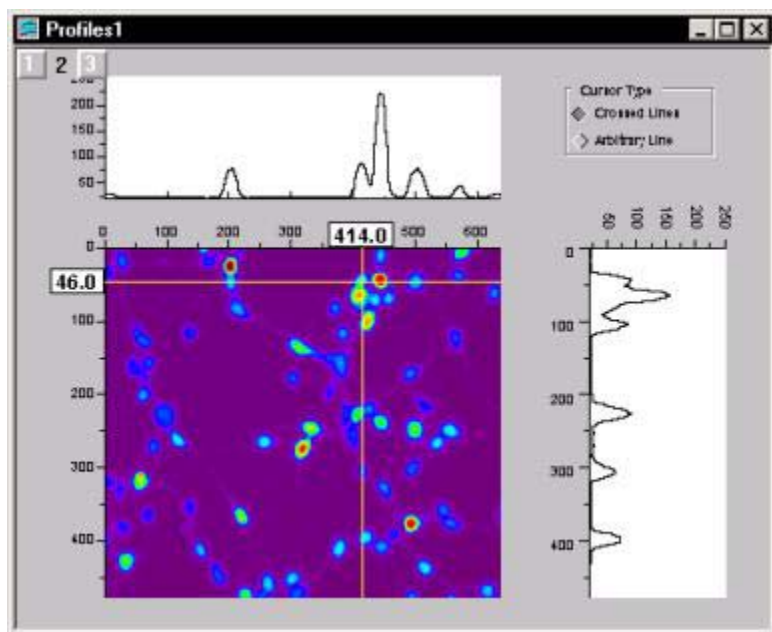
Cursor Type = Crossed Lines


- Drag the lines to position the cursor.
- Edit the text boxes associated with the vertical and horizontal lines to position the cursor.

Cursor Type = Arbitrary Line

1. Choose **Cursor Type** of **Arbitrary Line**.
2. Choose your cross-section by manipulating the handles at the end of the cursor, or by repositioning the cursor.

Viewing the Images X and Y Projections



 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Exporting an Image

To export an image in the matrix to a raster graphic image file, the internal data type of the matrix must be set to either short(4), int(2), or char(1). The internal data type is set in the **Matrix Properties** dialog box. To open this dialog box:

1. Select **Matrix:Set Properties**.

To export an image to a file:

1. Select **File:Export Image** when the matrix is active.

Worksheet to Matrix Conversion

Direct Conversion

Two common arrangements of **XYZ** worksheet data are:

- X data values in the 1st column, Y data values in the 1st row and Z values in columns 2 to N and rows 2 to M.
- Y data values in the 1st column, X data values in the 1st row and Z values in columns 2 to N and rows 2 to M.

X or Y values

	A[X]	B[Y]	C[Y]	D[Y]	E[Y]
1	-	1	2	3	4
2	10	0.00387	0.00595	0.02226	0.01272
3	20	0.11343	0.31848	0.12831	0.42911
4	30	0.12061	0.48388	0.37465	0.48951
5	40	0.21913	0.74349	0.38224	0.86464
6	50	0.66058	0.80696	0.59422	0.96697

X or Y values

Z values

In the Origin matrix, *columns* are mapped to X values and *rows* are mapped to Y values (refer to this topic). Thus, the **Direct** worksheet to matrix conversion method extracts the Z values and...

- ... if X data values are in the 1st row and Y data values are in the 1st column, creates a matrix of Z values that maintains the same row and column positions (N-1 columns x M-1 rows) as in [this illustration](#).

	A[X]	B[Y]	C[Y]	D[Y]	E[Y]
1	-	1	2	3	4
2	10	0.00387	0.00595	0.02226	0.01272
3	20	0.11343	0.31848	0.12831	0.42911
4	30	0.12061	0.48388	0.37465	0.48951
5	40	0.21913	0.74349	0.38224	0.86464
6	50	0.66058	0.80696	0.59422	0.96697

+

Direct Conversion to Matrix

Selected Range: Data6_A[1]E[6]

Data Format:

☒ X varies across columns ☐ Y varies across columns

☒ X values in first row ☒ Y values in first row

☒ Y values in first column ☒ X values in first column

Convert

=

	1	2	3	4
1	0.00387	0.00595	0.02226	0.01272
2	0.11343	0.31848	0.12831	0.42911
3	0.12061	0.48388	0.37465	0.48951
4	0.21913	0.74349	0.38224	0.86464
5	0.66058	0.80696	0.59422	0.96697

- ... if **Y** data values are in the 1st row and **X** data values are in the 1st column, creates a matrix of **Z** values that *transposes* the row and column positions (**N**-1 rows x **M**-1 columns) as in [this illustration](#).

	A[X]	B[Y]	C[Y]	D[Y]	E[Y]
1	—	1	2	3	4
2	10	0.00387	0.00595	0.02226	0.01272
3	20	0.11343	0.31848	0.12831	0.42911
4	30	0.12061	0.48388	0.37465	0.48951
5	40	0.21913	0.74349	0.38224	0.86464
6	50	0.66058	0.80696	0.59422	0.96697

+

Direct Conversion to Matrix

Selected Range
[Data6_A1]E[6]

Data Format:

☐ X varies across columns ☐ Y varies across columns

☒ X values in first row ☒ Y values in first row


☒ Y values in first column ☒ X values in first column

Convert

=

	1	2	3	4	5
1	0.00387	0.11343	0.12061	0.21913	0.66058
2	0.00595	0.31848	0.48388	0.74349	0.80696
3	0.02226	0.12831	0.37465	0.38224	0.59422
4	0.01272	0.42911	0.48951	0.86464	0.96697

To directly convert the active worksheet to a matrix:

1. Select **Edit:Convert to Matrix:Direct**. This opens the **Direct Conversion to Matrix** dialog box.
2. Determine whether your **X** values or **Y** values vary across columns and select the appropriate radio button (see above).
3. Use the **X values in first.../Y values in first...** check boxes, as appropriate.
4. Adjust the **Selected Range**, if necessary, and click the **Refresh**  button (note that you can pre-select worksheet data before choosing **Edit:Convert to Matrix:Direct** and your selection will register in the Selected Range box).
5. Click **Convert**.

Note: To convert the active Excel workbook to a matrix using direct conversion, select the desired Excel workbook data and then select **Window>Create Matrix**. No option to designate X and Y values is given. The data are directly written to the Origin matrix, maintaining row and column positions.

To learn more about direct conversion, review the WORKSHEET TO MATRIX.OPJ project located in your Origin \SAMPLES\ANALYSIS\WORKSHEET TO MATRIX folder.

Expanding Columns During Conversion

Some screen editors used to create ASCII files may have an upper limit for the number of characters allowed on a single line. This upper limit may even be less than the number of columns needed in the matrix. To compensate for this, one row of matrix data can be stored in multiple rows of an ASCII file.

Displaying this type of ASCII file in a matrix requires two steps. The first step creates a new worksheet and imports the ASCII file into it. The second step "expands" the worksheet data into a matrix. To do this:

1. Select **Edit:Convert To Matrix:Expand Columns**.
2. Specify the *number of ASCII file rows comprising one matrix row*.
3. Click **OK**.

Origin copies your worksheet data from the number of ASCII file rows into the first row of the matrix, repeating this procedure until all ASCII file rows have been converted. For example, if a matrix of 24 columns is stored in an ASCII file that is limited to 8 columns of data, then each row of matrix data (24 different values) would require 3 rows in the ASCII file. In this case, you would type **3** in the **Expand for**

Every Row dialog box. After clicking **OK**, a new matrix is created in which 3 rows of ASCII file data were used to construct each row of the matrix.

To learn more about expanding columns during conversion, review the WORKSHEET TO MATRIX.OPJ project located in your Origin \SAMPLES\ANALYSIS\WORKSHEET TO MATRIX folder.

2D Binning

This can be a useful data exploration technique when you have a sequence of measurements on a number of parameters and you want to explore dependencies between pairs of parameters.

To explore the relationship between the two variables in a 3D graph, you must first construct a matrix by binning the *X-Y paired* data in two dimensions.

To perform 2D binning:

1. Select the desired Y column in your worksheet (note that the second column of parameter measurements must be designated as an X column).
2. Select **Edit:Convert to Matrix:2D Binning**.

This opens the Create Bin Matrix dialog box.

3. Specify the bin limits and bin size for the X variable by entering **X-min** and **X-max** (extreme values are automatically detected) and **X-increment**.
4. Specify the bin limits and bin size for the Y variable by entering **Y-min** and **Y-max** (extreme values are automatically detected) and **Y-increment**.
5. Click **OK**.

A matrix is created by binning the X-Y paired data in two dimensions.

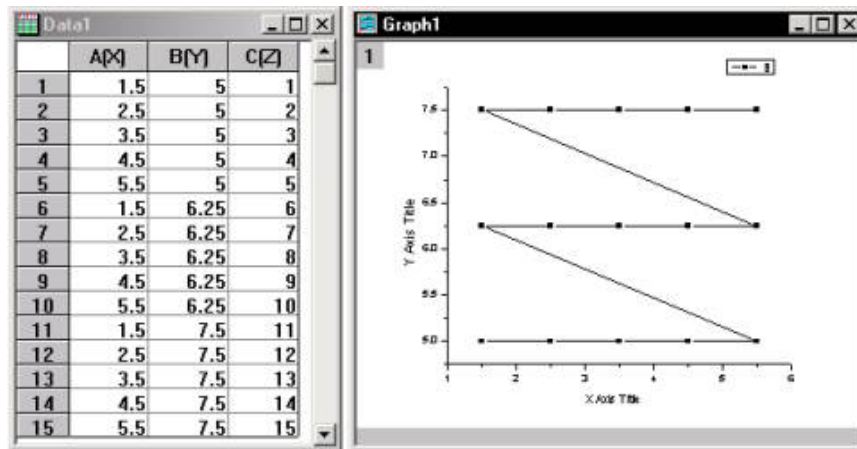
To learn more about 2D binning, review the 2D BINNING.OPJ project located in your Origin \SAMPLES\ANALYSIS\2D BINNING folder. Additionally, review the WORKSHEET TO MATRIX.OPJ project located in your Origin \SAMPLES\ANALYSIS\WORKSHEET TO MATRIX folder.

Converting Regular XYZ Data

In order for XYZ worksheet data to be classified as Regular, the XY data must meet the following requirements:

- Each X value must have the same number of Y values and each Y value must have the same number of X values.
- Both the X and the Y data values must be equally spaced. To check for regularity, you can plot the XY data sets as a line and symbol graph.

Plotting Worksheet Data to Check Regularity




To convert "regular" XYZ worksheet data to matrix data:

1. Select the worksheet **Z** column.
2. Select **Edit:Convert to Matrix:Regular XYZ**. The data are analyzed for the following before the matrix conversion is completed:
 - Origin searches for duplicates in the data set (multiple Z values for the same XY values) and replaces them with a mean Z value.
 - Origin analyzes the X,Y data sets to determine the increment, thereby also determining how many groups are present in both data sets.
 - Origin examines each group of the X,Y data set to look for fluctuations around the median value. If the fluctuations are larger than 25% of the increment size (determined previously), then the conversion quits.
 - The data is sent to Origin's regular conversion routine, after setting the **mat.res** property to 0. Thus, the **mat.res** property is now only an internal parameter - you no longer need to set this property value.

Note: If there is too much fluctuation in the X,Y data within each group, the algorithm will reject the data. The assumption is that there are only a few points within each group that deviate from the median. Therefore, if all the data points within a group are slightly different from each other and different only by a small amount compared to the step size from one group to the other, the algorithm may still reject the data set and the Regular conversion will fail.

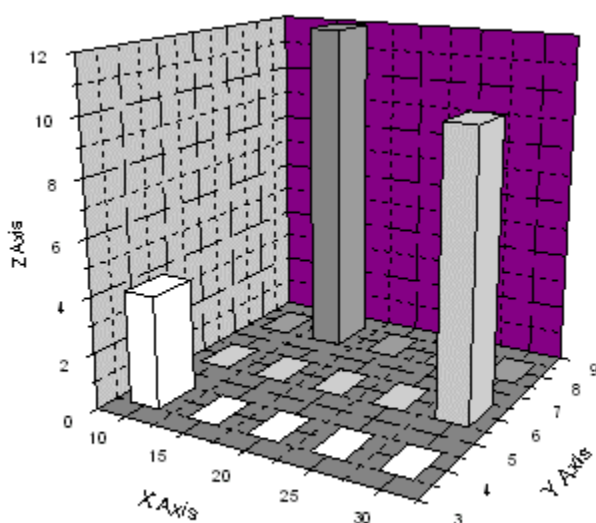
A matrix of Z values is created.

 See your Origin software to view a multimedia demonstration on this topic ([Help:Multimedia Demonstrations](#)).

To learn more about converting regular XYZ data, review the WORKSHEET TO MATRIX.OPJ project located in your Origin \SAMPLES\ANALYSIS\WORKSHEET TO MATRIX folder.

Converting Sparse XYZ Data

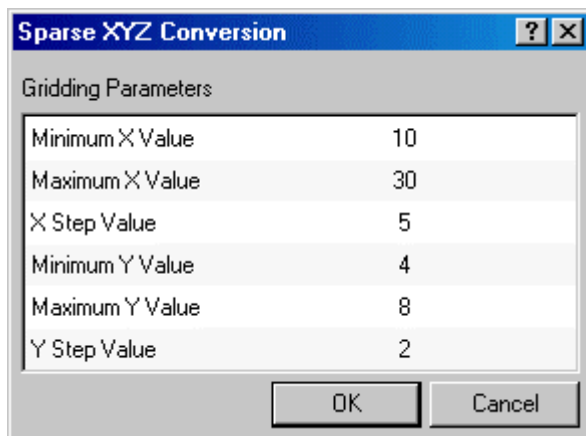
The **Sparse XYZ** worksheet to matrix conversion is similar to the Regular XYZ conversion (i.e. X and Y data values must be regularly spaced), except that in the case of the Sparse conversion, *missing XY pairs are acceptable*. The Sparse XYZ conversion allows you to create a 3D plot with Z values plotted only at select XY values, as in this 3D bar plot.



The Origin worksheet that supplied the source data for this graph looks like [this](#) (note that there are few data points):

Example - Sparse XYZ			
	A[X]	B[Y]	C[Z]
1	10	4	4
2	15	8	12
3	30	6	10

During the worksheet to matrix conversion, missing XY pairs are carried over (no interpolation is performed).



Thus, when converting the **Example - Sparse XYZ** worksheet with the **X Step Value** set to **5** and the **Y Step Value** set to **2** in the **Sparse XYZ Conversion** dialog box (other values left at the default), then the following matrix is created:

	1	2	3	4	5
1	4	-	-	-	-
2	-	-	-	-	10
3	-	12	-	-	-

To convert your worksheet to a matrix using the Sparse method:

1. Select the **Z** column.
2. Select **Edit:Convert to Matrix:Sparse XYZ**. This opens the Sparse XYZ Conversion
3. To edit the dialog box default values, click once on the value to engage edit mode (you can also use the arrow keys to move about the dialog box), and change the value.
4. Click **OK**.

To learn more about converting sparse XYZ data, review the WORKSHEET TO MATRIX.OPJ project located in your Origin \SAMPLES\ANALYSIS\WORKSHEET TO MATRIX folder.

Converting Random XYZ Data

If your worksheet to matrix data conversion process is not handled by Direct, Expand, 2D Binning, Regular, Sparse methods, then it should be treated as **Random** data. To convert random XYZ data to a matrix:

1. Select the **Z** column.
2. Select **Edit:Convert to Matrix:Random XYZ**.

This menu command opens the **Random XYZ Gridding** tool.



You have 5 gridding methods to choose from:

1. **Renka-Cline** and...
2. ...a modification of **Shepard's** method.

Both methods are implemented by calling the `nag_2d_scatter_interpolant` function provided in the NAG C Library e01 Interpolation. This function is documented in the NAG file `e01sac_cl05.pdf`. The documentation includes a discussion of the **NQ**, **NW**, and **RNQ** parameters for the modified Shepard's method.


When you installed Origin, you were given the option to install the **NAG** PDF files which document the NAG functions. If you clicked **Yes** to install these files, a \NAG PDFs folder was created with a subfolder for each library. If you did not install the PDFs, you can access them from your installation CD, and you can still install them to your hard disk by running the Origin **Add or Remove Files** program.)

3. Correlation.

The correlation method computes a new value for each cell in the regular matrix from the values of the points in the adjoining cells in the matrix that are included within the search radius. The computation is based on the Kriging method as can be found in Davis, John C., 1986. *Statistics and Data Analysis in Geology*. John Wiley & Sons, Inc. Second edition, pp. 383.

4. Quick Correlation
5. Weighted Average.

The weighted average method is a simple weighted average of the points with the weight equal to $1/r$, where r is the distance of each point from the cell. If there is no value within the search radius, the radius is increased until at least one point is encountered. Increasing the search radius means that each point is more inter-related to neighboring points, producing a smoother surface that may lose fine details.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

The Random XYZ Gridding tool provides a **Show Plot** check box and an **Apply** button. When **Show Plot** is selected and you click **Apply** or **OK**, a graph is created that shows the raw data as an XYZ scatter plot

and the interpolated grid as a mesh plot. Use the **Apply** button to compare gridding methods and find the closest correspondence between the scatter points (actual data) and the interpolated surface.

Random Gridding Options for Correlation, Quick Correlation, and Weighted Average:

- **Number of Columns/Rows:** Specifies the grid dimensions.
- **Search Radius:** Minimum number of grid points from the current position used for computing the value of the current cell. If the given position has less than three points in any of the four adjacent quadrants, the search radius is increased until there are enough points or a boundary is reached.
- **Smoothness:** Used by correlation (Kriging) method only. Relates values of points in the search radius to the computed value. Smaller values generate smoother surfaces.

Note: If duplicate XY pairs are found (multiple Z values for a given XY value), Z values are averaged.

To learn more about converting random XYZ data, review the WORKSHEET TO MATRIX.OPJ project located in your Origin \SAMPLES\ANALYSIS\WORKSHEET TO MATRIX folder.

Converting a Matrix into a Worksheet

There are two methods for creating a worksheet from matrix data:

- Direct Conversion

To directly convert the active matrix to a worksheet:

1. Select **Edit:Convert to Worksheet:Direct**.

This menu command creates a new worksheet and names the window **Datan**, where **n** is the lowest number available (not currently used in a worksheet name) in the project.

The worksheet is created with the same number of rows and columns as the associated matrix. The first worksheet column is designated as an X column, by default. Remaining columns are designated Y. Origin fills the worksheet with the matrix values, maintaining the same row and column positions in the worksheet.

- Creating a Worksheet with XYZ Columns

To convert the matrix to a worksheet with XYZ values:

1. Select **Edit:Convert to Worksheet:XYZ Columns**. This menu command opens the **Convert Matrix to Worksheet** dialog box.

⇒ To sort worksheet values by the X mapping values, select **X Constant 1st** from the **Conversion Type** drop-down list.

⇒ To sort worksheet values by the Y mapping values, select **Y Constant 1st** from the **Conversion Type** drop-down list.

2. Click **OK**.

This menu command creates a worksheet with X, Y, and Z columns. The cell values of the matrix are converted to Z data in the worksheet. The corresponding X and Y column values in the worksheet are set by the X and Y coordinate mapping information in the matrix.

Matrix Operations

Transposing

To transpose the active matrix:

1. Select **Matrix:Transpose**.

This menu command exchanges the matrix columns with rows, and rows with columns.

Inverting

To invert the active matrix:

1. Select **Matrix:Invert**.

This menu command transposes the matrix, and then divides the matrix by its determinant.

Flipping and Rotating

To flip the active matrix horizontally (first column becomes last, etc.):

1. Select **Matrix:Flip H**.

To flip each column vertically (last cell becomes first, etc.):

1. select **Matrix:Flip V**.

To rotate the matrix so that the columns become rows and the previously first value in the column becomes the last value in the row:

1. Select **Matrix:Rotate90**.

Shrinking

Matrix shrinking is a simple averaging of grid points. To shrink the active matrix:

1. Select **Matrix:Shrink**.

This menu command opens the **Shrink into 1x1 for Every** dialog box.

2. Type the column and row shrinkage factors. For example, if the original matrix is 100 columns by 20 rows, and you type **2** in the **Columns** and **Rows** text boxes, the matrix dimensions after shrinking will be 50 columns by 10 rows.

Expanding

Matrix expansion uses a bilinear interpolation method to add the inserted points. To expand the active matrix:

1. Select **Matrix:Expand**.

This menu command opens the **Expand for Every Cell** dialog box.

2. Type the column and row expansion factors. For example, if the original matrix is 100 columns by 20 rows, and you type **2** in the **Columns** and **Rows** text boxes, the matrix dimensions after expanding will be 200 columns by 40 rows.

Smoothing

To smooth the active matrix:

1. Select **Matrix:Smooth**.
2. Click **OK** at the prompt.

Origin does the following:

- If either the *number of columns* or the *number of rows* in the matrix is *less* than 32, Origin expands the matrix by a factor of two, then shrinks the matrix by a factor of two. Origin then repeats this process once more.
- If either the *number of columns* or the *number of rows* in the matrix is *greater* than 32, Origin shrinks the matrix by a factor of two, then expands the matrix by a factor of two.

For more information, see *Shrinking and Expanding* on page 131.

Computing the Volume Beneath a Surface

To compute the volume beneath the surface defined by the matrix:

1. Select **Matrix:Integrate**.

Origin performs a double integral over X and Y to compute the volume and reports the value in the Script window.

Matrixes: Windows and Templates

Saving a Matrix as a Template

To save a matrix with all formatting, properties, and dimensions, *but without any data*:

1. Select **File:Save Template As**.

This menu command opens the **Save As** dialog box. 'Matrix Template (*.OTM)' is selected (by default) from the **Save as Type** drop-down list.

2. Type the file name in the **File Name** text box and select the destination folder. You do not need to include the file extension in the **File Name** text box.

Attributes Saved with a Matrix Template

The matrix window is customized by editing its associated dialog boxes. These dialog boxes include:

- The **Matrix Properties** dialog box.

The **Matrix Properties** dialog box provides controls to specify the data type and display. See, *Setting the Matrix Data Properties* on page 113.

- The **Matrix Dimensions** dialog box.

The **Matrix Dimensions** dialog box provides options for customizing the matrix dimensions and the XY mapping relationship. See, *Setting the Matrix Dimensions and XY Coordinates* on page 114.

- The **Set Matrix Values** dialog box.

The **Set Matrix Values** dialog box allows you to specify a formula to fill the matrix. See, *Setting the Matrix Values* on page 116.

- The **Matrix Display Control** and **Page Color** dialog boxes.

The **Matrix Display Control** and the associated **Page Color** dialog boxes provide options for customizing the text color, style, and heading and grid display in the matrix, as well as the background color. The controls in this dialog box are identical to those found in the **Worksheet Display Control** dialog box. For a complete description of controls, see *The Worksheet Display Control Dialog Box* on page 42.

To open the **Matrix Display Control** dialog box:

1. Double-click in the matrix window (but outside of the grids).

To open the **Page Color** dialog box:

2. Click the **Page Color** button in the **Matrix Display Control** dialog box.

- The **ASCII Import Options for Matrix** and the **Data Import Options for Matrix** dialog boxes.

The **ASCII Import Options for Matrix** and **Data Import Options for Matrix** dialog boxes set the default import behavior for the matrix template. To open these dialog boxes:

1. Select **File:Import ASCII** and click the **Options** button in the Import ASCII dialog box.
2. To open the **Data Import Options for Matrix** dialog box, click the **Other Options** button in the **ASCII Import Options for Matrix** dialog box.

To learn more about the settings in these dialog boxes, see *Customizing the Default ASCII Import Settings* on page 72.

- The **ASCII Export Into** dialog box.

The **ASCII Export Into** dialog box sets the default export behavior for the matrix, including controlling the export of column names and controlling the data separator.

To open this dialog box:

1. Select **File:Export ASCII**.
2. Specify a **File Name** and **Save** the file.

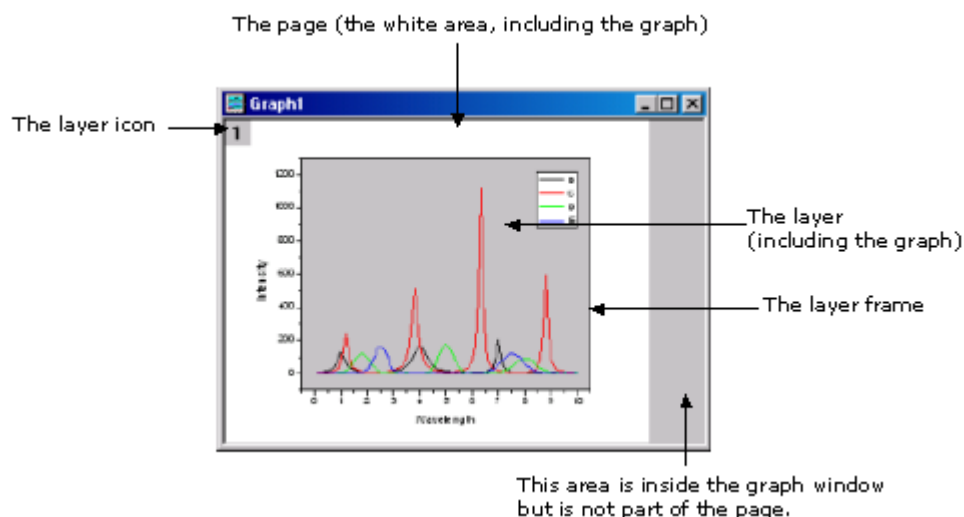
Upon clicking **Save**, Origin opens the **ASCII Export Into** dialog box. To learn about ASCII export options for matrix data, see *Exporting Matrix Data* on page 623.

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The Graph: Basics

The Page

Each graph window contains a single page. The page serves as a backdrop for the various elements (layers, axes, text, and data plots) that comprise the graph.



The small, gray **1** in the upper left corner of the graph page is the layer n icon (in this case, the layer 1). Every graph window page contains at least one, and possibly multiple, layers. If all layers are deleted from the page, the graph window is deleted.

Graph Page Dimensions

All Origin graph windows are created using a template. When you create a graph window, the default orientation and page dimensions are determined by settings saved with the graph template. Default page dimensions (width and height) are determined by the "printable area" of your particular printer driver.

To alter the default page dimensions of your graph window, click on the window to activate it, then:

1. From the menu, select **Format:Page**.

or

1. Double-click in the gray area outside of the graph page (but inside the graph window).

Both actions open the **Plot Details** dialog box. Note that the graph page icon is highlighted on the left side of the dialog box.

2. On the **Print/Dimensions** tab, **Dimensions** group, edit the **Width**, **Height**, and **Units** settings.

To reset the dimensions of the current graph page to the default printer page dimensions:

1. Right-click in the gray area to the right of the graph page (but inside the graph window).
2. From the shortcut menu, select **Fit Page to Printer**.

To learn more, see *Setting the Dimensions of the Graph Page* on page 300.

Setting the Page Orientation

Graphs can be presented in **landscape** or **portrait** page orientations. To change the page orientation of the active graph window:

1. Select **File:Page Setup**. This menu command opens the **Page Setup** dialog box.
 2. In the **Orientation** group, select the **Portrait** or **Landscape** radio buttons.
- or
1. Right-click in the gray area outside the graph page (but inside the graph window).
 2. From the shortcut menu, select **Edit:Rotate Page** (Note that the **Rotate Page** shortcut menu command has no affect when the view mode is set to Draft View or Window View).


When you change the page orientation by either of the above methods, Origin reverses the **Width** and **Height Dimensions** on the **Print/Dimensions** tab of the page's **Plot Details** dialog box.

Changing the View of the Page

Use these features to change the view of the graph page:

- The **View:Zoom In** and **View:Zoom Out** menu commands.
- The **Zoom In** and **Zoom Out** buttons on the Graph toolbar.
- The **Whole Page** menu command/button to restore the entire page view.

To zoom in on a portion of the graph page:

1. Select **View:Zoom In** or click the **Zoom In** button  on the **Graph** toolbar to display an enlarged, close-up view of the page in the active graph window.
2. After selecting the menu command or clicking the button, you must click on the desired zoom location in the graph window. Origin zooms the page, centering the zoom view at this location in the window. The axes are not rescaled.
3. To zoom in closer, re-select the menu command or click the button again.

After zooming in on the page, Origin provides scroll bars along the bottom and right side of the graph window.

4. Drag on the scroll bar slide control to scroll up/down or right/left across the page.

To zoom out of the graph page:

1. Select **View:Zoom Out**. This menu command is opposite in operation to the **View:Zoom In** menu command.

or

1. Click the **Zoom Out** button  on the Graph toolbar.

To restore the graph page to its original view:

1. Select **View:Whole Page** to fit the entire page to the graph window.

or

1. click the **Whole Page** button  on the **Graph** toolbar.

Note: These page zooming features should not be confused with the **Axis Zoom In** and **Axis Zoom Out** shortcut menu commands available by right-clicking in the axis region. The page zooming features *change the view of the page*. This affect is different from Origin's scaling features (including **Axis Zoom In** and **Axis Zoom Out**) that *change the display of the graph by rescaling the axis*.

The Layer

A typical graph usually includes at least three elements: a set of X and Y (and for 3D graphs, Z) coordinate axes, one or more data plots, and associated text and drawing objects. These elements are part of a movable, sizeable unit called a **layer**.

An Origin graph can have up to 50 layers on a single graph page. These layers may be superimposed or they may be separated. Layers can be linked spatially and their scales linked mathematically or they may be entirely independent of one another.

While a graph may have multiple layers, only one layer is **active** at any given time. To make a layer active, do one of the following:

1. Click on the X, Y, or Z axis (or anywhere inside the layer frame) of layer n .

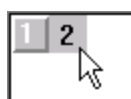
or

1. Click once on the layer n icon in the upper-left corner of the graph window.

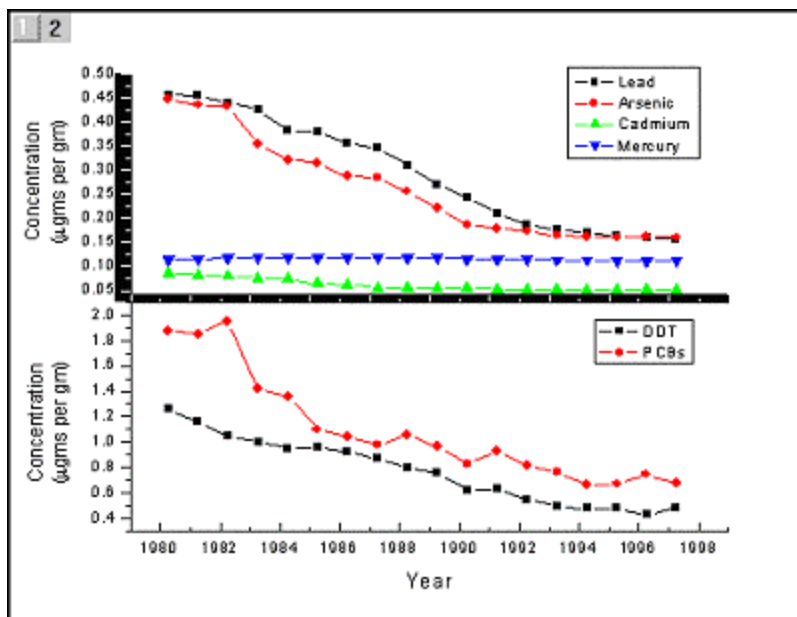
or

1. Click on an object (data plot, text object, etc.) that is attached to layer n (To find out more about object attachment considerations, see Layer Association, Attachment Method and Scaling Considerations.

When you perform operations that affect the layer (resize the layer, change the format of a data plot, etc.), you perform those operations on the *active* layer. In some cases, these operations (resizing, for instance) may affect other layers that you have linked to the active layer. When working with multi-layer graphs, try to remain aware of which is the active layer. The active layer is denoted by a depressed layer n icon in upper left corner of the graph window. In this illustration, layer 2 is the active layer.



The active layer will also be indicated by highlighted graph axes, if the **View>Show:Active Layer Indicator** menu command is checked. This menu command must be applied to each graph page.



Note: To configure Origin so that a graph layer can be made active only by clicking on the layer icon, select **Format:Page**. This menu command opens the Plot Details dialog box with the page (graph) icon selected on the left side of the dialog box. Select the **Miscellaneous** tab, then select the **Set Active Layer by Layer Icon Only** check box.

The Layer Frame

The layer frame is a hypothetical box, normally defined by the four XY axes (top X, bottom X, left Y, right Y) in a 2D graph layer. For 3D XYZ graphs, the frame is a rectangular box located outside of the XYZ axes. For both 2D and 3D graphs, the frame is *independent* of the axes. Though they frequently coincide, an axis can be offset from the frame. When you click on an axis to select a layer, the highlighted boundary that appears is the frame. Most layer display options such as the layer color, data clipping, and axis grid lines, are delimited by the frame boundaries.

To show the frame, activate a graph window, then:

1. Select **View:Show:Frame**.

This menu command only affects the active page. Other graph windows must be acted upon individually.

The Graph

The single layer graph includes one set of X, Y, Z (for 3D) coordinate axes, one or more data plots, and associated text and graphic elements. A graph may contain multiple layers.

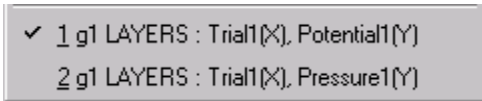
The Data Plot

A data plot is the graphic representation of one or more coordinate data sets, or a matrix, in a graph window. Data plots are created in the following ways:

- A data plot can be created from two or more data sets, such as an X and Y column in the worksheet. If a third data set (error bar or Z column) is employed, the resultant data plot contains *three* data sets.

- A data plot can be created from a Y data set and the associated row numbers (referenced as i) of the data set. If the worksheet containing the selected data set does not contain a designated X column and does not contain hidden X values, the data plot is created using row numbers.
- A data plot can be created from one Y data set which has been assigned an incremental X value (for that plotting instance).
- A data plot can be created from a matrix of Z values, each of which is mapped to an X and a Y value.

The data list at the bottom of the **Data** (graph window is active) menu lists the data plots included in the active layer of the graph window.



```

✓ 1 g1 LAYERS : Trial1[X], Potential1[Y]
  2 g1 LAYERS : Trial1[X], Pressure1[Y]
  
```

To see the list of data plots in a layer:

1. Select **Data** from the Origin menu bar (with a graph window active).

or

1. Right-click in the graph layer or on the layer *n* icon to open a shortcut menu.

The data list displays at the bottom of the shortcut menu. Listed are all the data plots in the current layer. A check mark appears next to the active data plot.

To activate a data plot:

1. Select a data plot from the data list.

or

1. Right-click inside the layer.
2. Choose **Set as Active** from the shortcut menu.

Creating a Basic Graph Using Plot Designations

At a basic level, creating a graph in Origin is a simple process. To plot data using Origin's worksheet Plot Designations and a built-in graph template:

1. Highlight one or more columns of worksheet data (or a range from one or more columns).
2. Select **Plot:Graph Type** (line, scatter, line + symbol, etc.).

or

2. Right-click on the selected worksheet data and select **Plot:Graph Type** from the shortcut menu.

or

2. Click a button on one of the graph toolbars (2D, 2D Extended, or 3D Graph).



It is not necessary to highlight the X column in the worksheet when plotting using Origin's plot designations. Origin will use the values in the first X column to the left of the highlighted Y or Z data column. If no X column is found to the left, Origin uses values in the first X column to the right. If the worksheet has no X column, Y or Z values are plotted against default row or incremental values.

To learn more, see *Understanding Column Associations in the Worksheet* on page 45 and *Designating a Column as X, Y, Z, Error, Label, or Disregard* on page 46.

Creating Data Plot Groupings

When you select multiple Origin worksheet or Excel workbook columns and create a graph, Origin *groups* the resulting data plots in the layer. Grouping provides for quick creation of presentation-ready graphs because *each data set in the group is assigned a differentiating set of plot attributes* -- line color, symbol type, etc. This occurs because the choices for each attribute (line color = black, red, green...; symbol shape = square, circle, triangle...; etc.), are *incremented* by dataset. Thus, the first column of Y data in a simple 2D line plot might be denoted by a black line; the second column of Y data might be denoted by a red line - the second color in the color list -- , the third column of Y data by a green line, and so on. Origin allows you considerable control over the way in which plot attributes are incremented -- or *not* incremented, or you may opt to disable the incrementing of data plot attributes entirely.

Example: Creating a data plot grouping:

1. Open a fresh worksheet and click the **Import ASCII** button  on the Standard toolbar.
2. Browse to the TUTORIAL subfolder in the Origin software folder and **Open** GROUP.DAT.
3. Drag your mouse across the three Y column headings of the **Group** worksheet.
4. Click the **Line & Symbol** button  on the 2D Graphs toolbar. Note that line and symbol color and symbol type have been incremented by data set.

You can manually group or ungroup data plots using the **Layer *n*** dialog box. To group or ungroup data sets:

1. Open the **Layer *n*** dialog box by double-clicking on the **layer *n*** icon in upper-left corner of the graph window.
2. To create a group, select the desired data sets from the **Layer Contents** list (use CTRL + select, SHIFT + select, or simply drag the mouse to select multiple data sets).
3. Click **Group**. To disable grouping, click on one of the grouped data plots in the **Layer Contents** list and click **Ungroup**.

Note: The following data plot types (and elements) *cannot be grouped*: 3D XYZ scatter, 3D XYZ trajectory, vector graphs, error bars, and data labels. You cannot *ungroup* the following data plot types: high-low-close charts, floating bar graphs, and floating column graphs.

Creating a Graph Without Regard to Plot Designations and Column Order

Use of default worksheet column associations (Plot Designations and column order) allows you create graphs in two quick steps. However, *you are not bound by worksheet column designations and column*

order when creating most 2D graphs. Origin provides two options for plotting without regard to these associations:

- Nonadjacent column selection.

Use CTRL + select to plot data from non-adjacent columns. Plot Designation is respected but enumeration of columns is unimportant.

Examples: Use CTRL + select to plot an X1 column and a Y2 column. Likewise, use CTRL + select to plot an X1, Y1, and Y2err column; the Y2err column supplies the Y error values for the Y1 column.

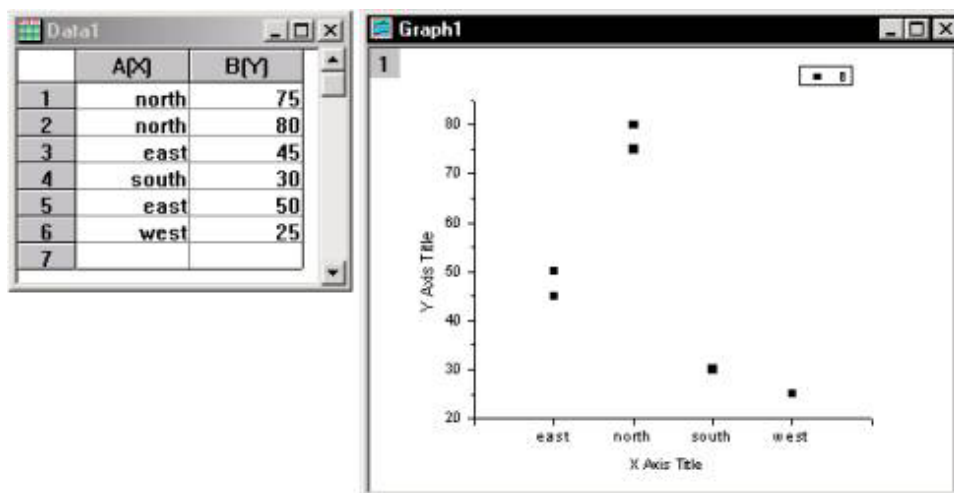
- The **Plot Setup** dialog box.

Plotting Categorical Data

Origin supports plotting categorical data in either X or Y columns. Before plotting categorical data, you must designate the column as Categorical:

1. Highlight the column.
2. From the menu, choose **Column:Set as Categorical**.

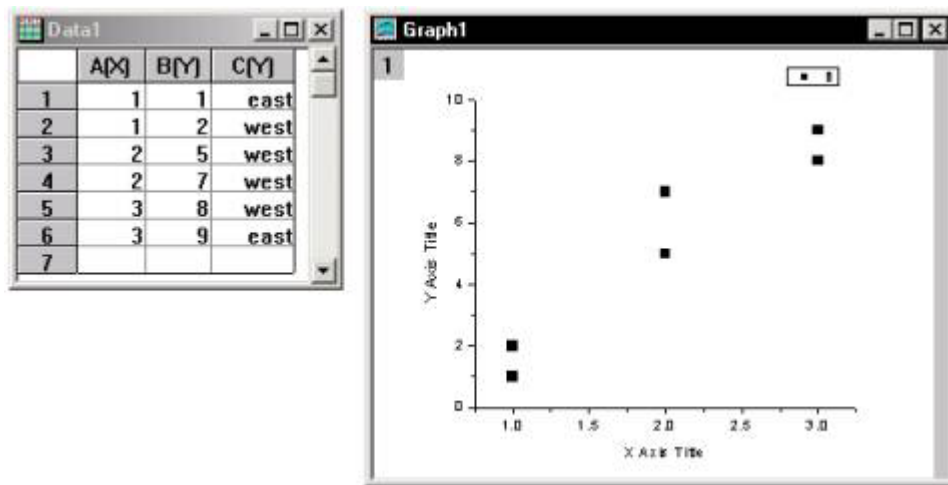
If your worksheet contains a *Categorical X* column and one or more associated Y columns, Origin interprets the X categories as X axis tick labels. These tick labels are ordered alphabetically (categories starting with numeric values are first) and evenly spaced along the axis. The Y data are plotted at X tick values ([see figure](#)).



If your worksheet contains a *Categorical Y* column, you can map categorical data "values" to plot symbol shape, color, size, or other plot attributes. ([see example](#)).

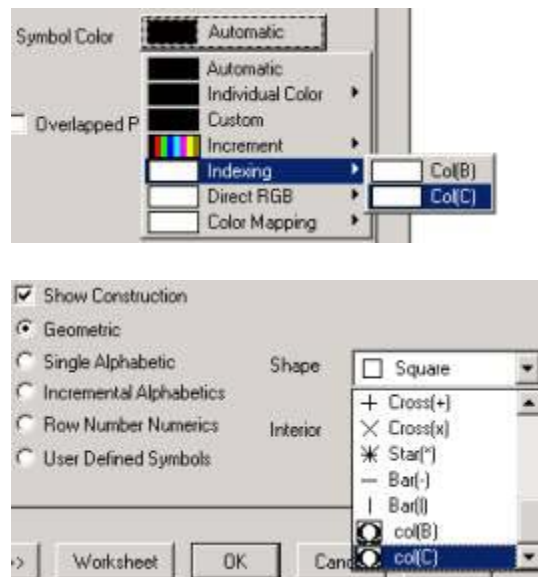
For example, in the following figure, the A(X) and B(Y) columns are plotted using the Scatter template.

Plotting the A(X) and B(Y) Columns

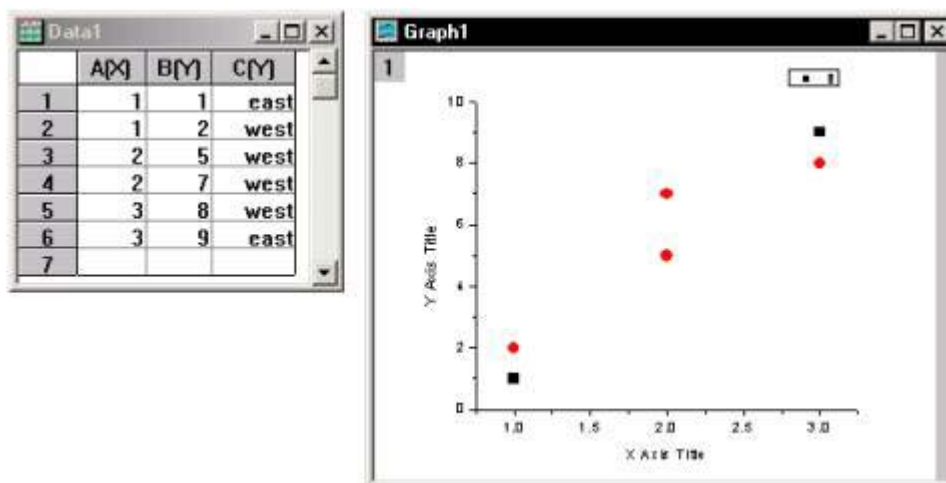


To display categories of data (east, west) using the same symbol shape and color, open the Symbol tab of the Plot Details dialog box and edit the Symbol Color and Shape drop-down lists as shown in the following figure. In this example the colors for each category will be *indexed* from the color list.

Mapping the Symbol Color and Shape to Column C



The resultant graph displays the data using the column C categories for both the symbol color and shape. To do this, Origin alphabetizes the categories (categories starting with numeric values are first). Because color indexing was selected, Origin assigns the first category the first color in the color list, the second category the second color, etc. Origin performs this same alphabetic assignment for all other mapped plot attributes.

The Resultant Graph

To add a legend to your graph layer that conveys information about the categorical data, select **Graph:Enhanced Legend**.

Also, see *Customizing the Legend for Categorical Data Plots* on page 416.

Creating a Graph when a Matrix is Active

When a matrix is active, you can create 3D surface and contour graphs. Unlike the worksheet, Origin always plots the complete range of matrix values, independent of any data selection. To plot your matrix data, make the matrix the active window and do one of the following:

1. Click the desired button on the 3D Graphs toolbar (**View:Toolbars**).

or

1. Select **Plot 3D:Graph Type**.

Origin plots the matrix values into the selected graph template.

Note: A matrix of Z values is linearly mapped in X by columns and linearly mapped in Y by rows. This eliminates multiple Z values (for example, folded surfaces like a sphere) and restricts the XY range to a rectangular grid. Additionally, Origin employs a "front to back" rendering mechanism when drawing 3D surfaces so that the data in the front draws over the data in the back.

Graphs: Windows and Templates

Graph Windows

As with worksheet and matrix windows, the graph window can be saved to a file (apart from the project file) and then re-opened in a different project. This can be useful in a variety of situations, for instance:

- This allows you to create a compact, editable file, that contains only supporting data. Subsequently, (1) insert this file into another Origin project file, (2) convert the file to a graphic file type (EPS, PDF, JPG, BMP, etc.), or (3) use it to create a custom template file.
- Graph, (OGG files) contain both the data plot and the supporting worksheet data. If you and another Origin user are working jointly on a manuscript, you could insert the OGG file into a

Word document and both graph and supporting data would be mutually available for editing by you or your colleague.

Graph window (OGG) files should *not* be confused with graph template (OTP) files. Unlike graph window (OGG) files, graph template (OTP) files *do not store data*.

To save the active graph window as an OGG file:

1. Select **File:Save Window As**.

or

1. Right-click on the window title bar and select **Save Window As**.

Both commands open the **Save As** dialog box.

2. Type the file name in the **File Name** text box. The graph (.OGG) extension is added automatically.

To open the graph window (OGG) file in your project:

1. Select **File:Open** when the project is open. This menu command opens the **File Open** dialog box.
2. Select **Graphs (*.OGG)** from the **List Files of Type** drop-down list.
3. Select your file and click **Open**.

To open the worksheet associated with the graph window (OGG) file:

1. Open the graph window file in your Origin project, as described above.

Activate the graph window and...

2. Right-click inside the graph page and select **Go toWorksheetName** from the shortcut menu.

or

2. Select **Format:Plot** from the Origin menu. This opens the Plot Details dialog box.
3. Click the **Worksheet** button at the bottom of the dialog box.

Graph Templates

Graph windows are created from graph template files with the extension *.OTP. When creating your graph, you can choose from one of Origin's built-in graph templates or create your own custom template. Origin provides built-in templates to create a broad range of 2D and 3D graphs. For an overview of Origin's built-in graph templates, see *The Graph: Types* on page 177.

A graph template file differs from a graph window file in that *templates do not store the data* in the graph. Template files determine all the page and layer characteristics such as page size, number of layers, inclusion of text labels, and data plot style information. A graph window that has been customized can be saved as a template for future use.

To save the active graph window as a template:

1. Activate the graph window and select **File:Template:Save As**

or

1. Right-click on the window title bar and select **Save Template As** from the shortcut menu.


Both commands open the **Save As** dialog box.

2. Enter the **File Name**. The graph template (.OTP) extension is added automatically.

3. Select a category or enter a custom category (Categories help you easily find your template when using the Template Library).

To plot data into your saved template, see *The Graph Template Library* on page 372.

For a discussion on creating custom graph templates, see page 371.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Attributes Saved with a Graph Template

The graph page, each graph layer on the page, the axes, the tick labels, the axes labels, and text or object annotations, as well as the data plots, all have properties that can be saved to a graph template.

Attributes saved with a graph template are controlled from various tabs on **Plot Details** dialog box:

- The page tabs of the Plot Details dialog box.
- The layer tabs of the Plot Details dialog box.
- The data plot tabs of the Plot Details dialog box.
- The function, data point, error, and label tabs of the Plot Details dialog box.

A note about data plot style holders:

The details (or data plot styles) of each of the data plots in your graph window are saved in *data plot style holders*. Data plot style holders contain information about the type of data plot (for example, scatter, line, or column) and the settings for the data plot (for example, the settings on the Plot Details Symbol tab). When you save a graph window as a template, each data plot in each layer of the graph window has an associated data plot style holder.

Thus, when you create a graph based on this custom template, for each layer in your graph, the first data plot in the layer will display according to the information stored in the first data plot style holder for that layer. The second data plot in the layer will display according to the information stored in the second data plot style holder for that layer, and so on. As you add data plots to the layer, Origin searches for a data plot style holder that is not currently in use (for example, if you removed a data plot from the layer contents), and displays the data plot using the first data plot style holder found. If you add *more* data plots to the layer than there are style holders, Origin will display the data plot using the information in the last data plot style holder.

Additionally, the attributes controlled by these dialog boxes are saved with the graph template:


- The Axis dialog box.

The Axis dialog box provides options for the customization of the axis, axis labels, axis scaling, grid lines, axis breaks, and tick label font and formatting.

To open this dialog box:

1. Activate the graph window and select **Format:Axes:AxisType**.

- The dialog boxes that control any annotations on the graph.






Additional annotations can be added to the graph window using the **Text** tool  or other graphic tools from the Tools toolbar.



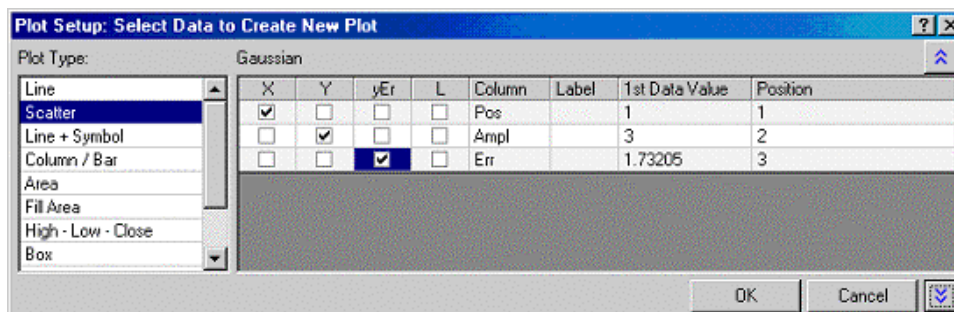
The Plot Setup Dialog Box

Plot Setup: Creating a Simple Graph

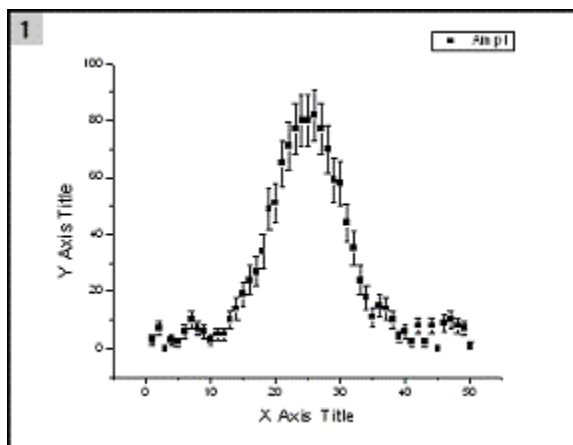
This short tutorial will show you how to create a simple graph with the Plot Setup dialog box:

1. Click the **New Worksheet** button  on the Standard toolbar.
2. Click the **Import ASCII** button  on the Standard toolbar.
3. Browse to the \Samples\Data folder (in your Origin folder), select Gaussian.DAT, and click **Open**. The file is imported to the worksheet and the worksheet is renamed **Gaussian**.
4. Click the **Scatter** button  on the 2D Graphs toolbar. The Plot Setup dialog box opens. Click the   buttons to display all three dialog box panels.
 - The middle panel, left side of the dialog box displays **Plot Type = Scatter** -- our chosen plot type.
 - The middle panel, right side of the dialog box has column headings that read: **X, Y, yEr, L, Column, 1st Data Value, and Position.**
 - X** = designate **Column** as **X**.
 - Y** = designate **Column** as **Y**.
 - yEr** = designate **Column** as **yEr** (Y error bar).
 - L** = designate **Column** as **Label**.
 - Column** = worksheet column name.
 - 1st Data Value** = data set's initial value.
 - Position** = column number (leftmost = 1).
5. For Column **Pos**, select the box under heading **X**.
6. For Column **Ampl**, select the box under **Y**.
7. For Column **Err**, select the box under **yEr**.

The settings in the middle panel of the dialog box should now look like this:







- Click **OK**. The Plot Setup dialog box closes. The following scatter graph is created with y error bars at each XY value.

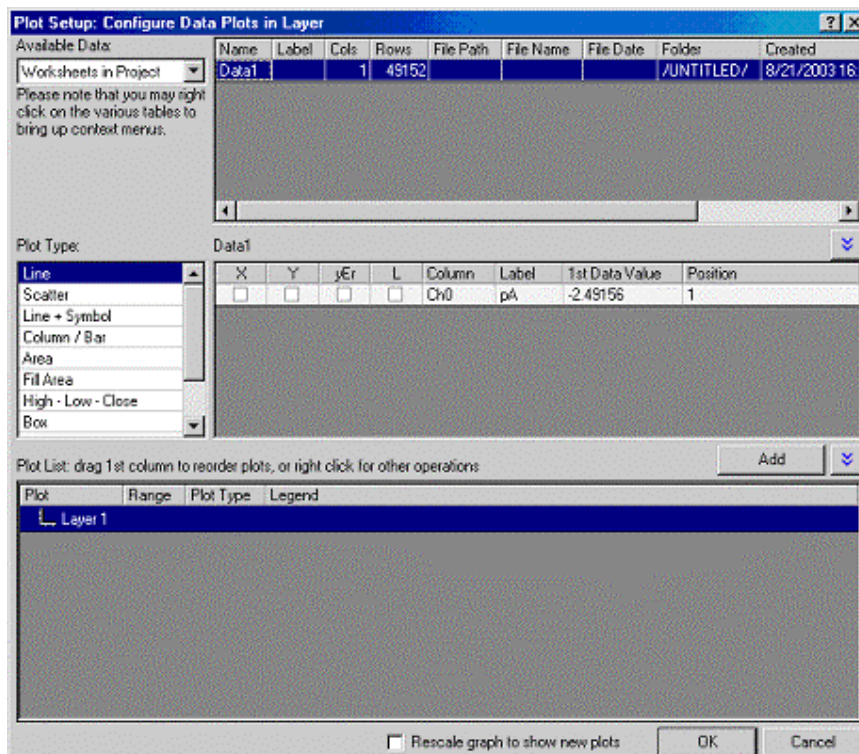


Plot Setup: Adding Plots to a Specific Graph Template

Use the Plot Setup dialog box to add data to a specific graph template. In this brief tutorial, we will add some pCLAMP data to a specialized Origin 2D line graph template formatted specifically for plotting the type of data commonly collected in electrophysiology work.

- Click the **New Worksheet** button  on the Standard toolbar.
- Select **File:Import:pCLAMP**, browse to the pCLAMP folder in your Origin program folder and select the file 96322001.ABF.
- Click **Add File(s)**, then click **OK**. The pCLAMP Options dialog box opens.
- Click **Import**. The file is imported into the active worksheet. The single data column is renamed **Ch0** and a **Column Designation** of **Y** is assigned to the column.
- Without selecting any data, click the **Open Template** button  on the Standard toolbar. This opens the **Open** dialog box.
- Set the **Files of Type** drop down list to **Graph Template (*.otp)**, browse the Origin program folder to locate the file PCLAMP.OTP and click **Open**. This opens a graph window based on the PCLAMP.OTP template.
- Right-click on the Layer 1 icon in the upper left corner of the graph window and select **Plot Setup**. The Plot Setup dialog box opens.
- Use the   buttons to display all three Plot Setup dialog box panels.

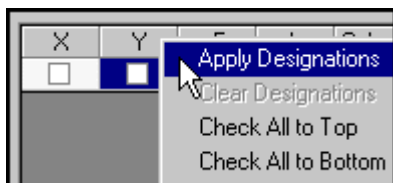
9. In the top panel, select the worksheet that contains the imported pCLAMP file. The middle panel should now display the single Ch0 data column. The dialog box should look something like [this](#):



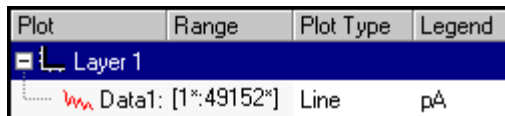
10. Select the check box under the **Y** column heading (Note: The ability to freely designate a data set as X, Y, error bar or label data -- independent of the worksheet Column Designation -- saves you the trouble of changing incompatible worksheet column designations before plotting your data).

or

10. Right-click on the column headings (in the middle panel) and select **Apply Designations** from the shortcut menu. This applies the worksheet Column Designation of the data.



11. Click **Add**. The plot is added to Layer 1, as indicated by the list control in the bottom panel. Note that the worksheet range (1:49152), plot type (Line), and legend symbol (pA) are also listed.








12. Select the **Rescale Graph To Show New Plots** check box at the bottom of the dialog box and click **OK**.

The data are plotted to the pCLAMP.OTP template and axes are automatically rescaled to show all data (A reminder message may report that Speed Mode is enabled in the graph page; to learn about this Origin feature, see the discussion of *Speed Mode* on page 298).

Plot Setup: Adding, Removing or Replacing Plots in a Graph Window

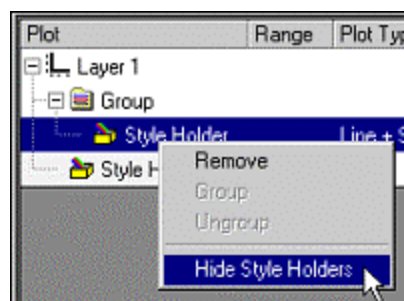
The Plot Setup dialog box provides a flexible interface for adding or removing data sets from your graph windows. You can add or remove any data set in the Origin project to your graph and you can do so without the need to change the column Plot Designations that control how the data are treated in the graph (as X, Y, error bar, label, etc.).

In this short tutorial, you will edit the layer contents of an existing graph, remove a data plot and replace it with two other data plots.

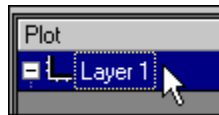
1. Click the **New Worksheet** button  on the Standard toolbar. A new worksheet opens.
2. Click the **Import ASCII** button  on the Standard toolbar. The Import ASCII dialog box opens.
3. Browse to the \Tutorial folder in your Origin directory and open the file **tutorial_1.dat**. The file is imported to the worksheet. The worksheet is renamed **tutorial1**.
4. Without select any data in this worksheet, click the **Line + Symbol** button  on the 2D Graphs toolbar. This opens the Plot Setup dialog box.
5. Click the   buttons and open all three panels in this dialog box.
6. In the top panel, select the **tutorial1** worksheet. The center panel of the Plot Setup dialog box now displays all of the data sets in the tutorial1 worksheet.
7. Leave the **Time** column designated as **X** (leave the check box selected) and the **Test1** column designated as **Y**. For the **Error1** column, select the check box under the **yEr** heading. Clear the remaining check marks under the Y column heading so that the center panel now looks like [this](#):

tutorial1		
X	Y	yEr
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Right-click inside the bottom panel of the Plot Setup dialog box and choose **Hide Style Holders** from the shortcut menu (see figure).



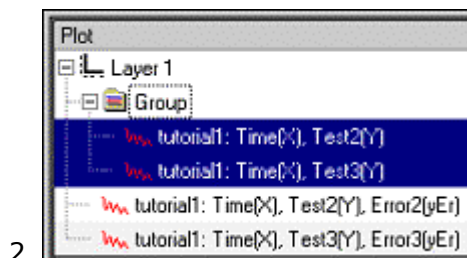
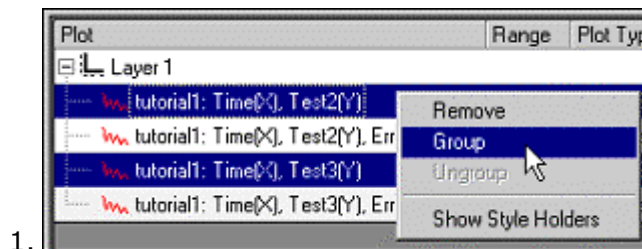
9. Highlight the **Layer 1** icon in the bottom panel ([see figure](#)), then click **Add**.



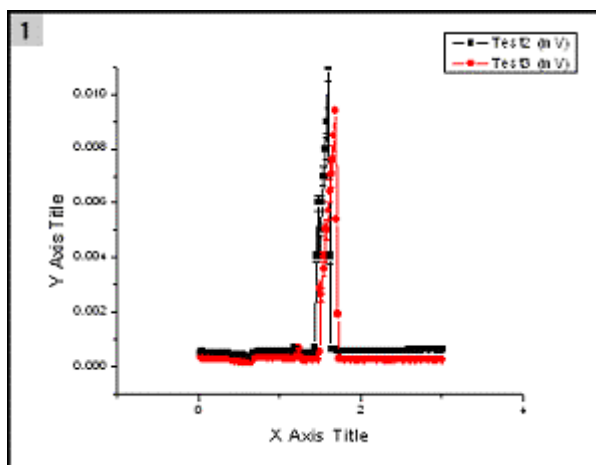
10. Click **OK**. A simple line + symbol plot with error bars is created.
11. Double-click on the layer 1 icon in the upper left corner of the graph window. This reopens the Plot Setup dialog box.
12. Select the **tutorial1** worksheet in the top panel of the Plot Setup dialog box. This populates the center panel of the Plot Setup dialog box with the list of data sets in the tutorial1 worksheet.
13. Clear the check boxes for the Test1 and Error1 data sets, and select the boxes for the Test2/Error2 and Test3/Error3 data sets so that the center panel looks like [this](#), then click **Replace**. The Test1/Error1 data sets are replaced by the Test2/Error2 and Test3/Error3 data sets.

tutorial1			
X	Y	yEr	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

14. Hold down the CTRL key and select the **Test 2** and **Test 3** data sets in the bottom panel (but *do not* select the **Error2** and **Error3** data sets), right-click and select **Group** from the shortcut menu ([see figure](#)). Grouping Test2 and Test3 will ensure that once the graph is replotted, plot attributes will increment by data set so that the two data sets can be clearly distinguished (see *Creating Data Plot Groupings* on page 140).








15. Click **OK**. The Test2/Error2 and Test3/Error3 data plots replace the Test 1/Error1 data plot ([see figure](#)).



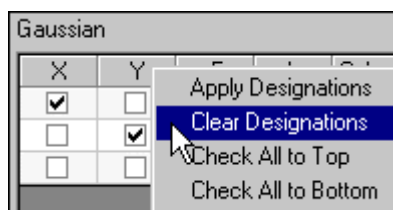
Plot Setup: Adding Plots to a Graph using Plot Designations

One of the advantages of using the **Plot Setup** dialog box to create graphs is that you are not bound to using the worksheet's column Plot Designations to create your graphs. However, in cases where the worksheet has been set up with the correct column Plot Designations, you can easily apply those designations to your graph, using a shortcut menu command in the Plot Setup dialog box. This brief tutorial will demonstrate this feature.

1. Click the **New Worksheet** button  on the Standard toolbar.
2. Click the **Import ASCII** button  on the Standard toolbar.
3. Browse to the \Samples\Data folder (in your Origin folder), select Gaussian.DAT, and click **Open**. The file is imported to the worksheet and the worksheet is renamed **Gaussian**.
4. Double-click on the column heading of the second Y column -- the one named **Err**. This opens the Worksheet Column Format dialog box.
5. In the **Options** group, choose **Y Error** from the **Plot Designation** drop-down list and click OK. The second Y column becomes a yEr (error bar) column.
6. Without selecting any data in the Gaussian worksheet, click the **Scatter** button  on the 2D Graphs toolbar. The Plot Setup dialog box opens.
7. Click the   buttons to display all three dialog box panels.

Note that the center panel of the dialog box lists all three data sets in the Gaussian worksheet. The worksheet Plot Designations have automatically been applied but you should know how to Clear or Apply those designations from this dialog box.

8. Right-click on any of the headings in the list controls in the center panel, and select **Clear Designations** from the shortcut menu (see figure). Note that this clears all Plot Designation check boxes in the center panel of the Plot Setup dialog box.








9. Right-click once more on any of the headings and select **Apply Designations**. This correctly applies the Plot Designations of the Gaussian worksheet.
10. Click **Add**, then click **OK**. A scatter plot is created with error bars on each data point.

Note that you are not bound to using the worksheet's column Plot Designations (in which case you could **Clear Designations** and specify new designations "on the fly" as in this next short tutorial).

Plot Setup: Adding Data Plots to a Graph without using Plot Designations

In this short tutorial, you will use the **Plot Setup** dialog box to create data plots without regard to the worksheet column Plot Designation.

1. Click the **New Worksheet** button  on the Standard toolbar. A new worksheet opens.
2. Click the **Import ASCII** button  on the Standard toolbar. The Import ASCII dialog box opens.
3. Browse to the \Tutorial folder in your Origin directory and open the file **tutorial_1.dat**. The file is imported to the worksheet. The worksheet is renamed **tutorial1**.
4. Without select any data in this worksheet, click the **Line + Symbol** button  on the 2D Graphs toolbar. This opens the Plot Setup dialog box.
5. Click the   buttons and open all three panels in this dialog box.
6. In the top panel, select the **tutorial1** worksheet. The center panel of the Plot Setup dialog box now displays all of the data sets in the tutorial1 worksheet.
7. Leave the **Time** column designated as **X** (leave the check box selected) and the **Test1** column designated as **Y**. For the **Error1** column, select the check box under the **yEr** heading. For the **Test2**, **Error2**, **Test3**, and **Error3** columns, select the boxes in the under the **Y**, **yEr**, **Y** and **yEr** headings, respectively. The center panel list controls should now look like [this](#):

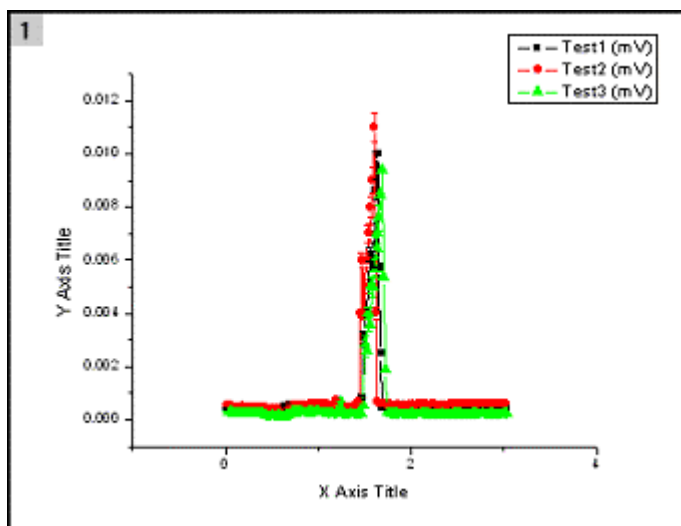
tutorial1							
X	Y	yEr	L	Column	Label	1st Data Value	Position
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Time	Time	0.021	1
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Test1	Test1	4.309E-4	2
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Error1	Error1	2.154E-5	3
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Test2	Test2	5.176E-4	4
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Error2	Error2	2.588E-5	5
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Test3	Test3	2.971E-4	6
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Error3	Error3	1.485E-5	7

Note that what you have done here is to assign worksheet column Plot Designations (X,Y, error bar, etc.) "on the fly." This was most convenient because the worksheet template used to import the tutorial1 data was not pre-configured to treat data columns as X, Y, yEr, Y, yEr, respectively. If it *had* been (i.e., we had created and saved a custom worksheet template specifically configured to designate imported data in this sequence), we might have found it more convenient to simply apply the worksheet Plot Designations to the data plots. To learn how this is done, see *Plot Setup: Adding Plots to a Graph using the Plot Designation* on page 151.

8. Click **Add**. The data sets are added to the graph layer (Layer 1). The bottom panel of the Plot Setup dialog box should now look like [this](#):

Plot	Range	Plot Type	Legend
Group			
tutorial1: Time [1*:181*]		Line + Symbol	Test1 (mV)
tutorial1: Time [1*:181*]		Line + Symbol	Test2 (mV)
tutorial1: Time [1*:181*]		Line + Symbol	Test3 (mV)
Style Holder		Text	
tutorial1: Time[X] [1*:181*]		Error Bar	Error1 (+mV)
tutorial1: Time[X] [1*:181*]		Error Bar	Error2 (+mV)
tutorial1: Time[X] [1*:181*]		Error Bar	Error3 (+mV)



9. Click **OK**. The Plot Setup dialog box closes. A Line + Symbol plot with error bars is created, with the 3 Y data sets grouped in the graph layer so that plot color increments by data set like [this](#):



Plot Setup: Editing the Plot's Display Range

You can alter the display range of a data plot *without* masking or otherwise altering the *worksheet's* display range. This is particularly advantageous when you have other plots which share worksheet data.

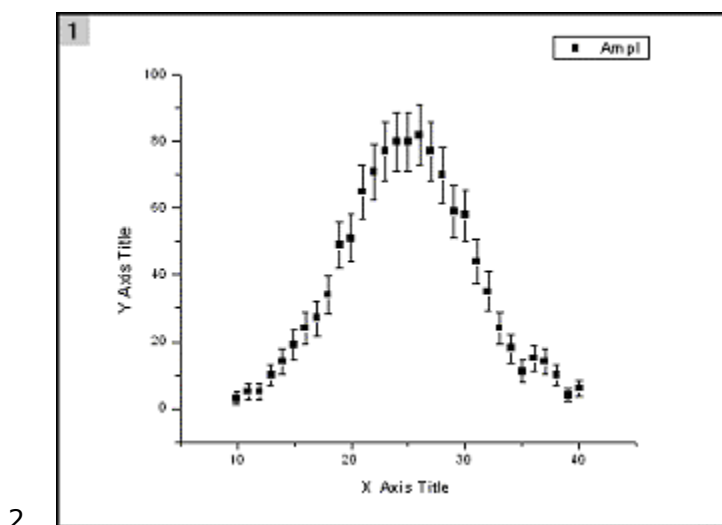
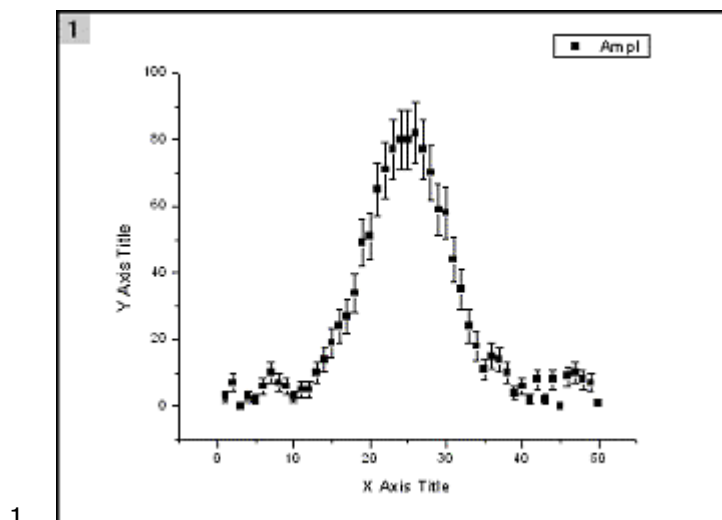
There are several ways to alter the data plot's display range; one is to use edit the **Range** settings in the bottom panel of the **Plot Setup** dialog box.


1. Double-click on the layer **n** icon in the upper left corner of the graph window. This opens the Plot Setup dialog box.
2. Use the   buttons to open all three panels in this dialog box.
3. Highlight the graph window's source worksheet in the top panel.
4. Click to the right side of the data plot's listed range, under the **Range** heading in the bottom panel (see [figure](#)). This produces a button which, when clicked on, opens the **Range** dialog box.

Plot	Range	Plot Type	Legend
Layer 1			
Gaussian : Pos(X), Ampl(Y)	[1*:50]	Scatter	Ampl
Gaussian : Pos(X), Ampl(Y), Err(yEr)	[1*:50*]	Error Bar	Err

5. Clear the **Auto** check boxes (if selected) and edit the **From** and **To** values, as needed.

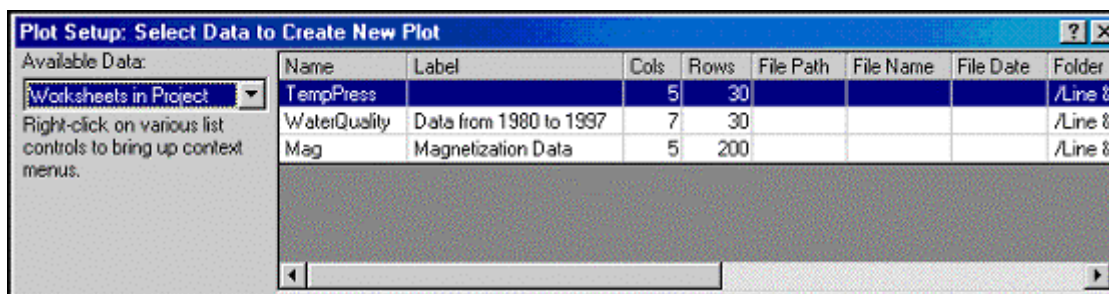
6. Click **OK** (in the Range dialog box).
7. Edit the **Range** for each plot, as needed.
8. If you *do not* wish to have the graph axes rescaled to accommodate the changes to the plot display, clear the **Rescale Graph to Show New Plots** check box at the bottom of the dialog box.
9. Click **OK**. The plot is redrawn with new **From** and **To** values. If you checked **Rescale...**, the axes are rescaled to reflect the changes to the plot range (see figure).



 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Plot Setup: Available Data (Top) Panel

The topmost panel in the Plot Setup dialog box lists datasets available for creating new plots or for adding to existing plots.



The Available Data Drop-Down List:

The setting on this drop-down list controls which data sets show on the list control to the right:

- **Current Worksheet:** Show only data sets in the current worksheet.
- **Worksheets in Folder:** Show only worksheets in the active Project Explorer folder.
- **Worksheets in Project:** Show all worksheets in the current Origin project (default).
- **Matrices in Folder:** Show all matrices in the active Project Explorer folder.
- **Matrices in Project:** Show all matrices in the project.
- **Loose Datasets:** Show all data sets that are not associated with worksheets or matrices.
- **Function Plots:** Show all data sets associated with functions.

The Data Set List Control (right-side of panel):

The list control on the right side of this panel lists all the available data, as per the **Available Data** drop-down list setting. Columns in this list control are:

- **Name:** Name of data sheet – lists name of worksheet, matrix, or loose dataset etc.
- **Label:** Lists window label for worksheets and matrices.
- **Cols:** Number of columns in the worksheet/matrix.
- **Row:** Number of rows in the worksheet/matrix.
- **File Path:** File path, if worksheet/matrix was filled by importing a data file.
- **File Name:** File name, if worksheet/matrix was filled by importing a data file.
- **File Date:** File date, if worksheet/matrix was filled by importing a data file.
- **Folder:** Project Explorer folder in which object (wks/matrix) resides.
- **Created:** Date when object (wks/matrix) was created.
- **Modified:** Date when object was last modified.

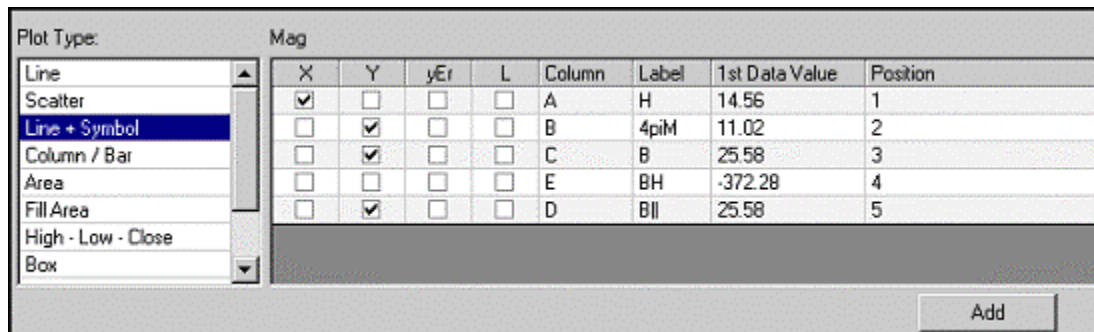
You can sort this list in ascending/descending order by clicking on any column heading.

Right-click on any column heading to bring up a context menu that has two options: **Hide**, and **Show All**. Hide will hide the current column from display. Show all will show all columns.

Click on any row of the list control to select a particular object such as worksheet or matrix, from the list. The middle **Plot Designations** panel updates to show the data from the selected object. You can select multiple items from this list by using SHIFT or CTRL keys. When multiple items are selected, the (middle) Plot Designations panel will display all those columns that are *common* to the selected objects.

Plot Setup: Plot Designations (Middle) Panel

This middle panel of the Plot Setup dialog box displays all datasets associated with the object(s) (worksheets, matrixes, loose data sets, etc.) that were selected in the (top) **Available Data** panel of this dialog box.



The Plot Type List:

This control lists available plot types. Availability is a function of which plot type or template you chose initially (which initiated the Plot Setup dialog box), or what plot type you are chose to edit.

The Plot Designations List Control:

X, Y, yEr, L, etc: The list control on the right lists all available datasets. There are multiple columns in this control. The plot designation column types (**X, Y, yEr**, etc.) are dependent on selected plot type (For example, when working with matrixes and 3D plots, the X, Y, Yerr columns will be absent and only a Z column will be present).

The plot designation columns have check boxes in all rows. Select one or more boxes (only one per row) to assign various columns/datasets for your plot. Note that you can select only one X column at a time (a single data plot or a plot group can have only one associated X column).

However, you can click the **Add** button to add a plot or a group, then change the designations and click **Add** again, to add more plots or groups to your graph.

Column: The worksheet column name (worksheets only).

Label: The worksheet column label (worksheets only).

Position: The worksheet column position (worksheets only).

1st Data Value: The value of first element in data set (worksheets only).

Click on any column heading to sort the entire list in ascending or descending order, on the sort column.

Additional Shortcut menu commands

A right-click on any column heading opens a context menu with these options (worksheets only):

Apply Designations: Use the worksheet's column plot designations (Note that if the worksheet has multiple X columns, only the first X column designation is applied).

Clear Designations: Clear all check boxes in the list control.

X Error Bars: Introduce an X Error Bar column.

Y Error Bars Plus/Minus: Introduce separate Plus and Minus Y error bar columns.

Allow Row# as X: Introduce a new row, corresponding to worksheet row numbers. Use this row to assign X values for the plot.

The Add/Replace Button:

Once you have assigned plot designations, click the **Add** button to add a data plot or a group of data plots, to the graph layer. Added plots are then listed in the (bottom) **Plot List** panel.

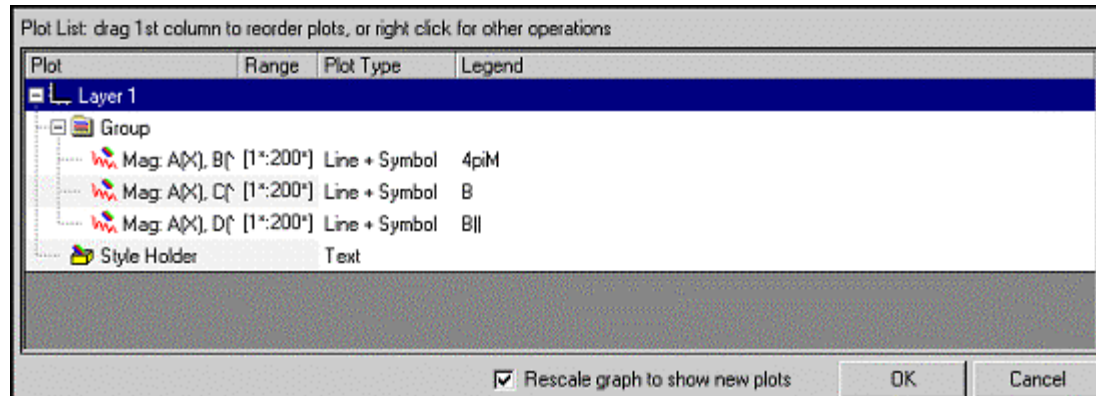
This button is sensitive to the selection in the Plot List panel. To add plots, the Plot List selection must be on **Layer**, on a **Group**, or on a **Style Holder**.

If plot designations have been assigned for multiple plots (in the middle panel), clicking **Add** will create a plot group and add it to the **Plot List** (bottom) panel.

When you select a particular data plot from the Plot List (bottom panel), the **Add** button becomes the **Replace** button. Clicking **Replace** then populates the middle panel and enables editing of the plot designations of the selected plot's data sets. You can change plot designations (or apply other Plot Designations functions), then click the **Replace** button. This replaces the plot in the graph window (the selected plot in the Plot List) with the data plot specified in the middle panel.

Plot Setup: Plot List (Bottom) Panel

This bottom panel displays the current plot list for the graph window in a tree format.

The Plot List Controls

Graph **Layers** form the top level in the tree hierarchy. If a graph template or an existing graph contains multiple layers, those layers will list in this panel.

The second tier in the hierarchy is formed by plot **Groups** (if they exist in the graph window).

Below the level of the groups are the **data plots** and **Style Holders** (A Style Holder contains the style information that is used to create the plot. For information on Style Holders, see page 145).

The **Range** column lists each data plot's display range. The values in this column are editable (for more information, see *Plot Setup: Editing the Plot's Display Range* on page 153).

The **Plot Type** column lists the plot type (from the middle panel) currently assigned to the data set.

The **Legend** column displays the legend text assigned to this data plot. This column is non-editable.

The **Rescale Graph to Show New Plots** check box forces Origin to rescale all graph axes to accommodate added or edited data plots.

Additional commands specific to the Plot List panel

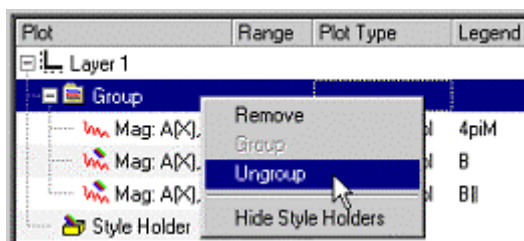
Hold down the left mouse button and drag data plots within a Group or a Layer to change plotting order (This is particularly useful for in the plotting grouped data because plotting order is linked to plot attributes. For more information, see *Customizing Grouped Data Plots* on page 358.

Right-click inside the tree list open a shortcut menu:

Show/Hide Style Holders. This is useful when you want to ignore graph template style information and manually assign plot attributes.

Remove. If a data plot is selected, use the shortcut menu's **Remove** command to remove the data plot from the group or layer.

To group multiple data sets in the layer, use SHIFT + SELECT or CTRL + SELECT to select multiple data plots, then right click, and choose **Group** from the shortcut menu. This creates a plot group.



Right-click on a Group in the tree and select **Ungroup** to ungroup the data plots.

Adding Data to an Existing Graph

Adding Data with the Add Plot to Layer Menu Command

This is a simple method for adding a range of data to an existing **line**, **scatter**, **line + symbol**, **column** or **area** graph:


1. Highlight your worksheet data.
2. Click on the existing graph window to activate it.
3. From the Origin menu, choose, **Graph:Add Plot to Layer:Graph Type**.

Dragging Data from the Worksheet Into the Graph

You can drag and drop worksheet data onto a graph window. When using this method, Origin relies on plot designations to create the plot. For example, if you select a Y column, or a range data in a Y column, and drag the data onto a graph window, Origin creates a data plot using the selected Y data and it's associated X data, if an X column exists. If the worksheet has no X column, Origin will plot the selected Y data against default X values.

To drag data from a worksheet to a graph:

1. Select the worksheet data (one or more columns or a range of one or more columns).
2. Point to the right edge of the selection range.

3. When the pointer looks like this , hold down the left mouse button and drag the data to the graph window.

4. Release the mouse button. The data are plotted.

If you drag multiple Y columns, or a range of multiple Y columns, onto a graph, Origin groups the associated data plots. When data plots are grouped, display properties are automatically incremented to differentiate data plots.

To specify a default plot type for drag-and-drop data:

1. Select **Tools:Options, Graph** tab.
2. Choose from one of four options on the **Drag and Drop Plot** drop-down list:
3. Select **Line, Scatter**, or **Line+Symbol**.
4. Select **Current** to create the plot using the style of the graph template (for example, line or scatter). If you have created a custom template with data plot style holders, Origin will search for the first available style holder. If there are no available style holders, Origin uses the style of the graph template.

Adding Data Using the Plot Setup Dialog Box

Add data sets to the active layer of a graph window using the Plot Setup Dialog Box. The Plot Setup dialog box allows you to specify the plot designation of each data set (**X**, **Y**, **xEr**, **yEr**, or **L**) regardless of the worksheet column plot designations. The dialog box also allows you to add data from different worksheets to the same graph window in a single operation.

Use the Plot Setup dialog box to create 2D plots as well as these 3D XYY and 3D XYZ plot types:

- 3D Scatter
- 3D Trajectory
- 3D Bar
- 3D Ribbon
- 3D Wall
- 3D Waterfall

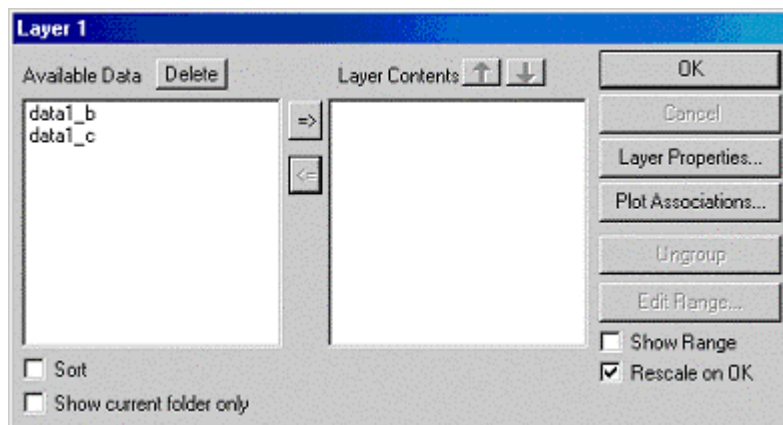
To open the **Plot Setup** dialog box when a graph window is active, do one of the following:

1. Click one of the graph buttons on the **2D Graphs** or **2D Graphs Extended** toolbars, *without* selecting any data to plot.
2. Click the **Plot** button in the **Select Template** dialog box (Template Library) either without selecting data *or* without selecting data that is appropriate for the chosen graph template.
3. Right-click on the layer icon in a graph window (the window need to contain plotted data), and select **Plot Setup** from the shortcut menu.
4. Double-click on the graph window layer icon.
5. ALT + double-click on the graph window layer icon to open the **Layer n** dialog box, then click the **Plot Setup** button.

Adding Data Using the Layer n Dialog Box

The Layer n Dialog Box


Layer n Dialog Box Controls



- The Available Data List

This list box includes *all* the data sets in the project that are available for plotting (all worksheet columns that are not designated as X or disregarded, temporary data sets, matrices, and Excel workbook columns).

To display a data set(s) in the layer:

1. Select the data set(s) in the **Available Data** list.
2. Click the  button to add the data set(s) to the **Layer Contents** list.


- The **Sort** Check Box

Select this check box to sort the data sets in the **Available Data** list alphabetically; when cleared, the data sets are listed in order of creation.

- The **Show Current Folder Only** Check Box

Select this check box to display the data sets that are located in the active **Project Explorer** folder; clear to display all the data sets in the project.

- The **Layer Contents** List

This list box includes all the data sets currently plotted in the layer. To remove a data set from the layer, highlight the data set(s) in the **Layer Contents** list and Click the  button.


Note: If the data sets are part of a data plot group, the data set names are prefaced with a **gn** notation, where **n** is the group number (see explanation under the **Group/Ungroup** Button).

- The Up and Down Buttons (Layer Contents)

The drawing order in the layer is determined by the order of the data sets in the **Layer Contents** list. The data set at the *top* of the Layer Contents list plots *first* in the layer (in back); remaining data sets plot in front of the first plot, following the order in the Layer Contents list.

Use these buttons to move data sets up or down in the **Layer Contents** list.

To move a data plot to the front in the layer:

1. Select the data set in the **Layer Contents** list.
2. Move it to the bottom of the list using the  button.

- The Delete Button

Delete all *highlighted* data sets in the **Available Data** list. This also removes any worksheet columns and data plots associated with the deleted data sets.

- The Layer Properties Button

Click on the **Layer Properties** button to open the Plot Details dialog box with the layer *n* icon selected in the left side of the dialog box. Edit the tabs in this dialog box to control the layer display.

- The Plot Setup Button

Click the **Plot Associations** button to open the **Plot Setup** dialog box.

The Plot Setup dialog box provides a flexible interface for adding or removing data sets from your graph windows. You can add or remove any data set in the Origin project to your graph and you can do so without the need to change the column Plot Designations that control how the data plot in the graph (as X, Y, error bar, label, etc.).

To learn more, see *The Plot Setup Dialog Box* on page 146.

- The Group/Ungroup Button

Click this button to *group* or *ungroup* the selected data sets. The button is only available when two or more data sets in the **Layer Contents** list are highlighted. Grouping data sets allows for automatic incrementing of the data plot color, line type, etc. within the data plot group.

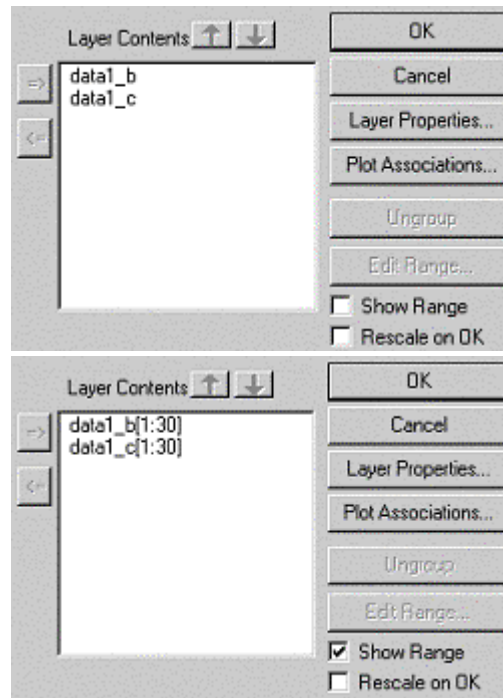
- The Edit Range Button

Click **Edit Range** to change the plot display range for a selected data set. This button is only available when *one* data set is highlighted in the **Layer Contents** list.

The Edit Range button opens the **Plot Range** dialog box. Specify the starting and ending worksheet rows for displaying the data plot in the graph.

- The Show Range Check Box

Select to show the current display range for all data sets included in the **Layer Contents** list. The Layer Contents now includes the display range of the data sets in the graph (for example, data1_b[1:30]).



- ⇒ The first number in the display range is the worksheet row number of the first data value plotted.
- ⇒ The second number is the row number of the last worksheet value plotted.

- **The Rescale on OK Check Box**

Select this box to automatically rescale the layer axes to show all the data after the **Layer *n*** dialog box is closed (if you have added data, axes may need rescaling before all data show in the plot).

Clear the check box, to maintain the current axes scales.

Specifying the Start and End Worksheet Rows

You can specify the starting and ending worksheet rows for displaying a data plot from the **Layer *n*** dialog box or from the data plot's shortcut menu.

To access this option from the **Layer *n*** dialog box:

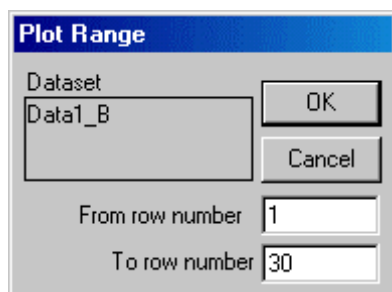
1. Double-click on the layer icon that includes the data plot whose range you want to edit. This action opens the **Layer *n*** dialog box.
2. Select the data plot (the primary data set) from the **Layer Contents** list and click **Edit Range**. (Note: If the data plot is part of a data plot group, you cannot click the Edit Range button without first *ungrouping* the data sets. To avoid ungrouping, edit the data plot's range using the shortcut menu command (see next).

To access this option from the data plot's shortcut menu:

1. Right-click on the data plot whose range you want to edit and select **Edit Range**.

Both of the above actions open the **Plot Range** dialog box.

Plot Range Dialog Box Controls



The **Dataset** list box displays the primary data set for the selected data plot.

Use the **From Row Number** and **To Row Number** text boxes to set the data plot display range.

Note: To reset the display range of the data plot back to the original range, select **Data:Reset to Full Range** from the Origin menu, or right-click on the data plot and select **Reset to Full Range**.

Importing a Single ASCII File into a Graph Window

You can import a single ASCII file into the *active* layer in the active graph window by one of three methods:

1. From the menu, select **File:Import:Import Wizard**. The **Import Wizard** opens to the **Data Source** page.

or

1. You can drag and drop a file onto an Origin graph window.

When you drag and drop files onto an Origin graph window, this sequence of events occurs:

1. If your DOFILE.OGS file contains specific information about handling of your dropped ASCII file (you would have to have written a LabTalk script to handle your custom import routine), then the file is imported as per the instructions in DOFILE.OGS and plotted in a graph window.
2. If you have *not* modified DOFILE.OGS *and* you have *not* created an **Origin Import Filter** (*.OIF) file for the dropped file type (extension), the **Import Wizard** opens to the **Data Source** page. From this point, you can configure the Import Wizard to import your file. Optionally, you could simultaneously create and save an .OIF file to simplify import of future files sharing the structure of your dropped ASCII file. To learn more about how to do this, see Import Wizard.
3. If you *have* created an Origin Import Filter (*.OIF) file for the dropped file type (extension), Origin uses this filter to import your data. If multiple applicable .OIF files are found, a dialog opens listing all filters in the folder, and the user selects a filter from the list. When the correct filter has been selected, the data are imported and plotted without opening the Import Wizard.

To learn more about dragging-and-dropping files onto an Origin graph window, see *Origin's Drag-and-Drop Data File Support for Graphs* on page 167.

or

1. You can click the **Import ASCII** button  on the Standard toolbar.

This opens the **Import ASCII** dialog box.

2. Choose a file.
3. Click the **Options** button to customize the default ASCII import settings.
4. Click **Open**.

The file is imported and plotted in the active graph window.

Note: Header information in an ASCII file can be inserted into a graph as a text label. For more information see *Inserting Variables Extracted from Imported ASCII Files into Text Labels* on page 422.

Importing Multiple ASCII Files

You can import multiple ASCII files into the *active* layer in the active graph window by one of three methods:

1. From the menu, select **File:Import:Import Wizard**. The **Import Wizard** opens to the **Data Source** page.

or

1. You can drag and drop files onto an Origin graph window.

When you drag and drop files onto an Origin graph window, this sequence of events occurs:

1. If your DOFILE.OGS file contains specific information about handling of your dropped ASCII file (you would have to have written a LabTalk script to handle your custom import routine), then the file is imported as per the instructions in DOFILE.OGS and plotted in a graph window.
2. If you have *not* modified DOFILE.OGS *and* you have *not* created an **Origin Import Filter** (*.OIF) file for the dropped file type (extension), the **Import Wizard** opens to the **Data Source** page. From this point, you can configure the Import Wizard to import your file(s). Optionally, you could simultaneously create and save an .OIF file to simplify import of future files sharing the structure of your dropped ASCII file(s). To learn more about how to do this, see Import Wizard.
3. If you *have* created an Origin Import Filter (*.OIF) file for the dropped file type (extension), the files are imported to a worksheet and the data are plotted without opening the Import Wizard.

To learn more about dragging-and-dropping files onto an Origin graph window, see *Origin's Drag-and-Drop Data File Support for Graphs* on page 167.

or

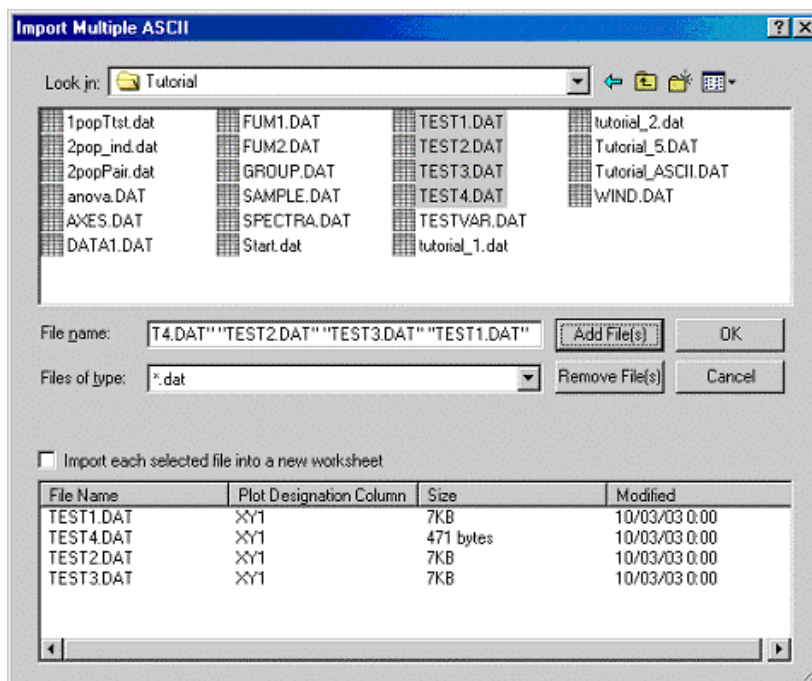
1. You can click the **Import Multiple ASCII** button  on the Standard toolbar.

This opens the **Import Multiple ASCII** dialog box.

Note: The Import Multiple ASCII dialog box allows you to import data into a *graph or worksheet*. If you open the dialog box when a graph window is active, you can import the data into a worksheet by selecting the **Import Each Selected File into a New**

Worksheet check box. To learn more, see *Importing Multiple ASCII Data Files into a Single or Multiple Worksheets* on page 76.

The Import Multiple ASCII Dialog Box (Graph Window Active)



Selecting a File for Import

To add a file to the lower list box, double-click on the file in the "Files" list box, or click on the file in the box and click **Add File(s)**.

Removing a Selected File

To remove a file from the lower list box, select the file in this list box and click **Remove File(s)**.

Assigning Plotting Designations

To facilitate plotting your data, Origin includes a **Plot Designation Column** section in the list of selected files. You can select a plotting designation arrangement or you can type an arrangement by double-clicking on the default value. This action opens a combination box from which you can select or type a new arrangement.



XY1	Origin will import all the columns. Origin assumes the first column contains X values and <i>all remaining columns contain Y values</i> . In this case, the 1 indicates that the last character Y is repeated for all remaining columns.
DXY1	Origin will import all the columns. Origin assumes the first column contains values that should be Disregarded. Origin assumes the second column contains X values and the remaining columns contain Y values. 1 indicates that the last character Y is repeated for all remaining columns.
XY	Origin will import the first and second columns as X and Y values respectively.
XY2	Origin will import all the columns. However, in this case Origin assumes the first column contains X1 values, the second column contains Y1 values, the third column contains X2 values, the fourth column contains Y2 values, and so on. In this case, the 2 indicates that the last two characters X and Y are repeated for all remaining columns.
XYE	Origin will import the first, second, and third columns as X , Y , and Y error values respectively.
XYZ	Origin will import the first, second, and third columns as X , Y , and Z values respectively.

Alternatively, use the following letters to specify a custom column designation arrangement:

X: X values

Y: Y values

Z: Z values

D: disregarded values - these values are not imported

E: Y error values

H: X error values

L: label values

When you type or select a plotting designation arrangement, the arrangement determines the number of columns that are imported, as well as their plotting designations. If a number is included as a terminating character, it indicates the "repeat unit" in the arrangement.

- **Example 1:** If you select XY1, Origin imports all the columns. Origin assumes the first column contains X values and all remaining columns contain Y values. In this case, the "1" indicates that the last character "Y" is repeated for all remaining columns.
- **Example 2:** If you select XY2, again Origin imports all the columns. However, in this case Origin assumes the first column contains X1 values, the second column contains Y1 values, the third column contains X2 values, the fourth column contains Y2 values, and so on. In this case, the "2" indicates that the last two characters "X" and "Y" are repeated for all remaining columns.
- **Example 3:** If you select XYE2, Origin imports the file using the following arrangement: XY(YError)Y(YError)Y(YError)... as "Y" and "E" are repeated.

In addition to assigning plotting designations for each data file separately, you can apply your **Plot Designation Column** selection for

- *one* data file.

- all the data files in the list box.

To apply the selection to all the data files:

1. Right-click on the **Plot Designation Column** selection that you want to apply and select **Apply Plot Designation Selection to All** from the shortcut menu.

Note that you can also display the data file path from this shortcut menu.

- selected data files in the list box.

To apply the selection to selected data files:

1. Select the data files in the list box. Right-click on the **Plot Designation Column** selection that you want to apply and select **Apply Plot Designation Selection to Selection** from the short cut menu.

Note that you can also display the data file path from this shortcut menu.

Importing the Selected Files

Click **OK** to plot all files in the lower list box into the active layer of the graph window, based on the **Plot Designation Column** settings.

You can also drag-and-drop ASCII data files into a graph. To learn about this, see *Origin's Drag-and-Drop Data File Support for Graphs* on page 167.

Note: Header information in an ASCII file can be inserted into a graph as a text label. For more information see *Inserting Variables Extracted from Imported ASCII Files into Text Labels* on page 422.

Origin's Drag-and-Drop Data File Support for Graphs

You can drag-and-drop ASCII, simple binary, user-defined, and Thermo Galactic SPC data files into graph windows and have the data plotted automatically.

To drag and drop files onto an Origin graph window:

1. Make your graph window active.
2. Select the desired file(s) in Windows Explorer.
3. Drag the file(s) over the Origin taskbar button and hold them there until Origin becomes active.
4. Drag and drop the file(s) onto the Origin graph.

An Explanation of Origin's Drag and Drop Methods

Origin's Drag-and-Drop file import routines are handled by one of two methods:

- The older method involves calling a LabTalk section in a file called DOFILE.OGS (see *A Note on Adding Drag-and-Drop Support for New File Types*, below). This user-modifiable file is installed as part of your Origin software. This file has been used by Origin to import SigmaPlot, Minitab, and Thermo Galactic SPC data files and you may have modified this file yourself, adding your own LabTalk script to handle drag-and-drop import of unrecognized (by Origin) data files.
- The newer method relies on user-created **Origin Import Filter** (*.OIF) files, created using the Origin **Import Wizard**.

When supported file types (ASCII, simple binary, Thermo Galactic SPC or user-defined) are dropped into an Origin graph window, Origin first looks for data handling instructions in DOFILE.OGS. If they are not found there, Origin looks for an appropriate Origin Import Filter (OIF) file. If no OIF file exists, the Import Wizard is opened.

If Origin *does* find that an appropriate OIF exists for handling the "dropped" file(s), it will import the file(s) automatically (without opening the Import Wizard) into the *active layer* in the *active graph window*.

Simultaneously, a hidden worksheet (based on the Target Window Template, if specified, or on the default worksheet template if *no* Target Window Template is specified) is created and the data are imported into this worksheet.

If multiple files are dropped onto the graph window, each file will go into a separate worksheet window, created based on the Target Window Template.

Adding Drag-and-Drop Support for New File Types

Origin provides two mechanisms by which you can add drag-and-drop support for user-defined file types:

- Create a filter using the Import Wizard.

This method requires that you supply the import code in the form of an Origin C function.

Your Origin C function should have the following prototype:

```
int YourFunctionName(Page& pgTarget, TreeNode&
trFilter, LPCSTR lpCszFile, int nFile)
```

where:

pgTarget: A reference to a Page object of type worksheet or Matrix. This would be what you defined in your filter or on the 1st page of the wizard, as the target window.

Note1: The target window and template specification on Page 1 is only used when creating new windows (as would be the case when you use **File:Open** or under some conditions during drag-and-drop importing). When choosing **File:Import**, if your active window is of the same type as your target window specification, no new window is created and a reference to the page object for the active window is passed to your function. If the active window *is* of a different type, a new window is created using the specified template, and the page reference to this new window is passed.

trFilter: A reference to a TreeNode object that holds all the filter settings from your filter file, or from your wizard specifications, in a tree structure.

lpCszFile: The full path and name of the file that is being imported.

nFile: The file index number in an ordered sequence of imported files (e.g. If you drag-and-drop *n* files, or try to **Open/Import** *n* files, your function gets called *n* times, and **nFile** is the file count for the file being processed.

Note2: For an example that illustrates writing a custom function, refer to the OC file \OriginC\OriginLab\EarthProbe.c. This file is used by Origin for importing Earth Probe data.

- Add a section to the DOFILE.OGS script file.


When any file is dropped onto Origin from Windows Explorer, Origin looks to the DOFILE.OGS script file located in your Origin folder. It then looks for a section named [OnOpen*Extension*], where *Extension* is the file extension of the dropped file. If found, that section is executed and the file name is passed as an argument.

To learn more about this method, review the AUTOMATION.OPJ sample project located in your Origin \SAMPLES\PROGRAMMING\AUTOMATION subfolder.


Note: Because Origin looks to DOFILE.OGS before looking to see whether there is an Import Wizard filter for the dropped file type, you must remove any previously added file import code from DOFILE.OGS if you plan to use an Import Wizard filter file to import your user-defined file types.

Note: More on information on drag-and-drop data import is available in the Knowledge Database on the OriginLab website. Search in Category = Import/Export, and use the key word "drag".

Creating a Data Plot Using the Draw Data Tool

You can create a data plot using the **Draw Data Tool**  on the **Tools** toolbar. Data plots created with the Draw Data Tool can be edited, manipulated, and analyzed in the same way as any other data plot.

To create a data plot using the Draw Data tool:

1. Activate the graph window.
2. Click on the **Draw Data Tool** .
3. Make sure that the correct target graph layer is active and place the cursor on the graph.
4. Double-click to create data points. The **Data Display** tool opens (if not already open) and displays the **X** and **Y** values for each created data point.
5. When you have finished adding data points, click on another tool (on the **Tools** toolbar) to exit the "drawing" mode.

When you use the Draw Data Tool, you are simultaneously creating a hidden worksheet named **Drawn** (worksheets are automatically enumerated, with $n = 1, 2, 3, 4$, etc.). The primary data set of the data plot created using the Draw Data Tool is named **Drawn_b**.

To open the hidden worksheet for the drawn data set:

1. Right-click on the data plot and select **Go to Drawn** from the shortcut menu.

or

1. Double-click on the data plot to open the **Plot Details** dialog box.
2. Click the **Worksheet** button (at the bottom of the dialog box).

Both operations open a **Drawn** worksheet window containing the **A(X)** and **B(Y)** data sets. These are the coordinate values of the drawn data plot.

Data Labels and Error Bars

Data Labels

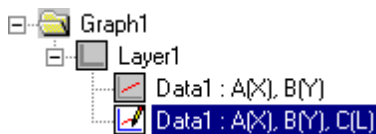
You can use a data set to label specific data points or axis scale values in a graph. Either worksheet or Excel workbook column values can be used as data labels in a graph window.

To include worksheet data label values in the graph window, the column containing the data label values must be designated as **Label**. Text or numeric values in a worksheet Label column plot as data labels for the associated Y column values *immediately to the left* of the label column (a row-by-row association is created). In the case of nonadjacent column selection, the selected label column provides data labels for the

selected Y column. If more than one Y column is selected, Origin labels the selected column nearest to the left of the label column.

To use Excel workbook column values as labels, use the **Select Data for Plotting** dialog box.

When a data plot includes data labels, the **Plot Details** dialog box lists a data label icon beneath the associated data plot icon on the left side of the dialog box. When the data labels icon is selected, a **Label** tab displays on the right side of the dialog box.



Note: You can use text formatting switches in the cells of a worksheet Label column. For example, to display a data label in bold font style, type **\b(YourLabel)** in the worksheet cell.

Adding Error Bars

Adding Error Bars to Your Graph

There are several methods for using the values in a data set to create **X** and/or **Y** error bars in your 2D graphs. If you are creating a new graph, the simplest method is to:

1. Designate one or more error bar columns in the worksheet. Note that the error bar data column should be to the *right* of the data column with which it is associated.
2. Select both your **Y** data *and* your **error bar** data.
3. Choose your 2D plot type (scatter, line & symbol, column/bar, etc.).

(This method is detailed in the online **Tutorial 2: Worksheets, Data Import and Plotting**).

or


1. Use the **Plot Setup** (Origin worksheet) or the **Select Data for Plotting** (Excel workbook) dialog boxes to plot a data set as error bars. Note that these two dialog boxes allow you to create error bars from a data set, *independent of the error bar data set's Plot Designation*.

Note that it is possible to use these data sets to add error bars to new or *existing* graphs.

Adding an Error Bar Data Set to the Worksheet

Error bars can also be added to an existing graph window by creating an error bar column in the worksheet, filling the column with values, and adding the error bar data set to the layer using the **Layer n** dialog box.

To add error bars to the graph via the **Layer n** dialog box:

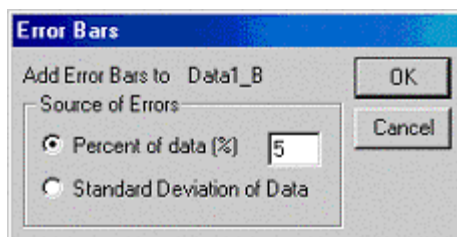
1. Insert or add a column in the worksheet for your error bar data. This column should be to the *right* of your Y data set.
2. Designate the column as an error bar column.
3. Hold down the ALT key and double-click on the layer icon in the upper left corner of your graph window (For multi-layer graphs, be sure to click on the layer icon for the layer that contains the data points to which you want to add error bars). This opens the **Layer n** dialog box.
4. Highlight the error bar data set in the **Available Data** list of the **Layer n** dialog box.
5. Click the  button to move the error bar data set to the **Layer Contents**.
6. Click **OK** to add the error bars to the data plot.

Note: The **Plot Setup** dialog box allows you to add data sets -- including error bar data sets -- to an existing graph window. For more information, see *Plot Setup: Adding, Removing or Replacing Plots in a Graph Window* on page 149.

Adding Error Bars using the Add Error Bars Menu Command

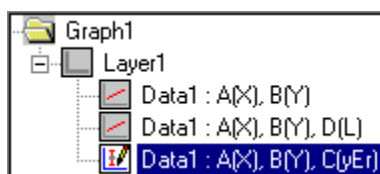
You can add error bars to a graph without creating an error bar data set in your worksheet:

1. Select **Graph: Add Error Bars** when the graph window is active.



This method creates error bar values by calculating either a specified percent of the data set value or the standard deviation of the data set.

When a data plot includes error bars, the **Plot Details** dialog box lists an error bars icon beneath the associated data plot icon on the left side of the dialog box. When the error bars icon is selected, an **Error Bar** tab displays on the right side of the dialog box. Use this dialog box to customize the appearance of error bars. See, *The (Plot Details) Error Bar Tab* on page 340.





Adding Error Bars using the Plot Setup Dialog Box

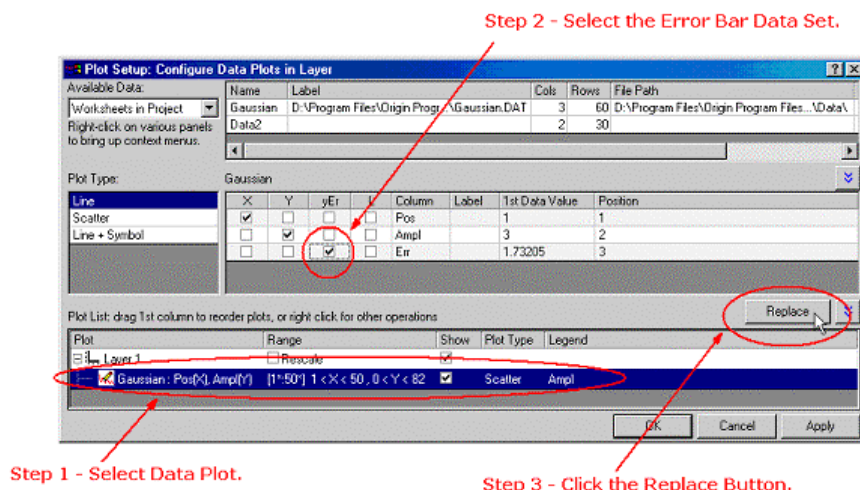
You can use the **Plot Setup** dialog box to add error bars from a worksheet data set to a new or existing data plot. Any worksheet data set can be used to create the error bars, independent of the error bar data set's Plot Designation.

To add error bars using the Plot Setup dialog box

- To add error bars to an existing plot:

Double-click on the layer icon for the layer containing the data plot to which you want to add error bars. This opens the **Plot Setup** dialog box.

Use the  and  buttons, as necessary, to show all three panels of the dialog box.



Click **OK** to close the dialog box and add error bars to the data plot.

- To designate an error bar data set as you are creating a new graph window, see *Plot Setup: Creating a Simple Graph* on page 146.

How does the Data List Display an Error Bar Data Plot?

When an error bar data set is added to a data plot, Origin adds a new "data plot item" to the data list at the bottom of the **Data** menu. Like all data plots in the data list, this new entry contains a primary data set (the rightmost data set). In this case, the primary data set is the selected error bar column.

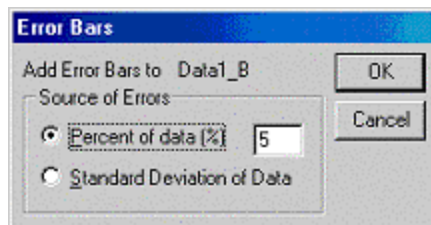
Origin adds the extra data plot to the data list to simplify editing the respective data plot elements.

Thus, if a check displays next to the listed data plot which contains the Y primary data set, select this data plot from the data list to open the data plot tab (for example, Symbol) of the Plot Details dialog box. Additionally, select **Format:Plot** to open the dialog box.

If a check displays next to the listed data plot which contains the yEr (or xEr) primary data set, select this data plot from the data list to open the Error Bar tab of the Plot Details dialog box. Additionally, select **Format:Plot** to open the dialog box.

Reference: The Add Error Bars Dialog Box

Error Bars Dialog Box Controls



The Percent of Data (%) Radio Button and Text Box

Select the **Percent of Data (%)** radio button to create error bars based on a percentage of each plotted data point. Enter the percent value in the associated text box. Origin calculates $n\%$ of each Y column value (for the plotted data). An error bar column is added to the worksheet to the immediate right of the active data plot's Y column (primary data set). The Percent of Data values

are placed in the corresponding rows of this column. If a worksheet doesn't exist, it is created. Columns are created for each data set in the layer. An error bar column is created to the immediate right of the primary data set.

The Standard Deviation of Data Radio Button

Select the **Standard Deviation of Data** radio button to calculate the standard deviation of the primary data set in the data plot. Origin adds an error bar column to the immediate right of the active data plot's primary data set column in the worksheet. The calculated standard deviation value is added to each cell (up to the maximum row number of the associated data set). The standard deviation is used as the source of the error bars in the data plot.

Plotting Functions

Plotting a Function into a Graph Window

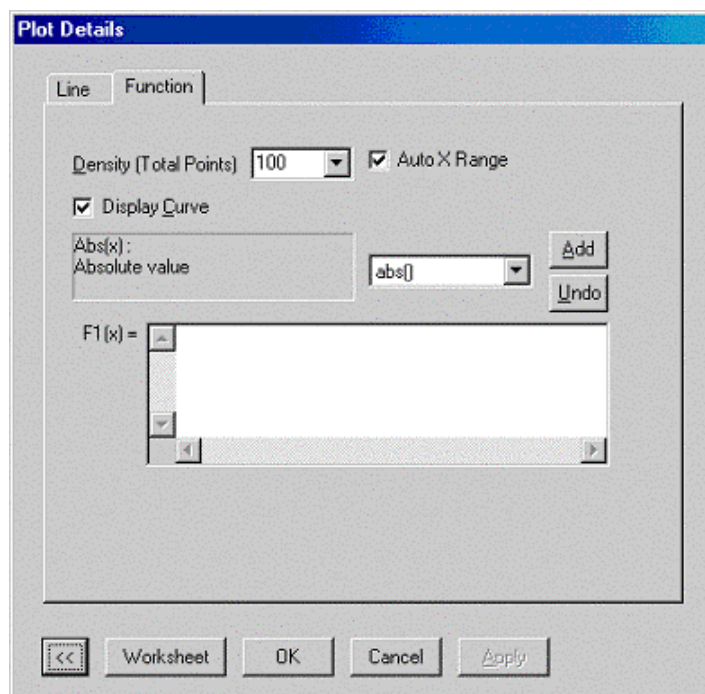
To add a function to the active graph window:

1. Select **Graph: Add Function Graph**.

This menu command opens the **Function** tab of the Plot Details dialog box. The as-yet-undefined function and its position in the graph window element hierarchy are visible in window on the left side of the Plot Details dialog box. Use the Function tab controls to define the function.



The (Plot Details) Function Tab



The Density (Total Points) Combination Box

Specify the number of data points to display in the function graph from this combination box.

The Display Curve Check Box

Select this check box to view the function graph in the graph window.

The Function Controls and Function (Fn) Text Box

Common mathematical and statistical distribution functions are available from the function drop-down list. The view box to the left of the drop-down list displays a function summary including the required arguments for the currently selected function. After you select a function from the drop-down list, click the **Add** button to display the function in the *Fn* text box.

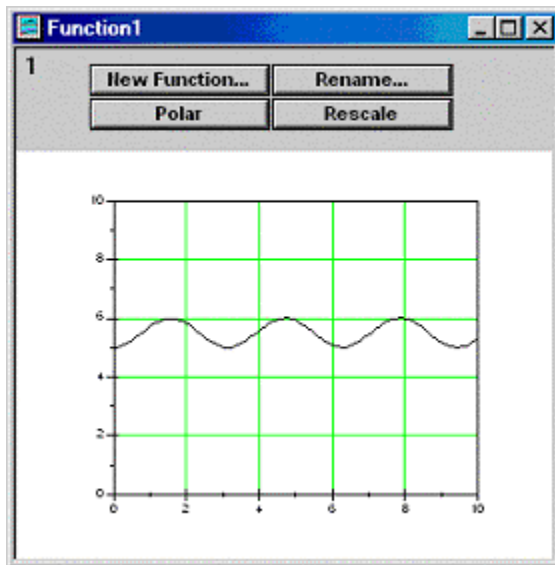
In addition to accessing common built in functions with the function drop-down list/Add button, you can type a function directly in the text box using any operators recognized by Origin. For multiplication, you must include the multiplication operator (*). Additionally, you can type in any of Origin's built-in functions that aren't available from the drop-down list, or any functions that you have defined.


The **Undo** button is provided to return the text in the *Fn* text box to the previous display. Thus, click this button to return one step in your editing process.

To complete the editing process, click the **Apply** or **OK** button.

Plotting a Function into a Function Graph Window

Origin has a special graph template that is designed for displaying and manipulating function plots. To plot a function into this special template:



1. Click the **New Function**  button on the Standard toolbar. This action opens a **Function n** graph window as well as the **Function** tab of the Plot Details dialog box. For information on defining your function in the (Plot Details) Function tab, see *Plotting a Function into a Graph Window* on page 173.

Edit this graph by double-clicking or right-clicking on any element in the graph. Additionally, you can use the controls at the top of the window to customize the function graph.

The New Function Button

Click this button to add a new function graph to the window. This action opens the (Plot Details) Function tab. For information on using this tab, see *Plotting a Function into a Graph Window* on page 173.

The Rename Button

Click this button to rename the active function.

To make a function active, right-click on the function and select **Set as Active** from the shortcut menu. If the command is unavailable, the function *is* currently active. Alternatively, select the desired function from the data list at the bottom of the **Data** menu or at the bottom of the layer shortcut menu. A check displays next to the active function (or data plot).

The Polar/Cartesian Button

Switch between displaying *Cartesian* and *polar* coordinates. When the function graph is displayed with polar coordinates, the **Set Angular Range** button is available. Click **Set Angular Range** to open the **Angular Range** dialog box. Specify the starting and ending angular values, as well as the angular increment. In addition to setting the angular range, two buttons are provided to display the polar coordinates in a clockwise or counterclockwise orientation.

The Rescale Button

Click this button to rescale the axes, if needed. For example, click this button after magnifying the function graph with the **Enlarger** tool from the Tools toolbar.

Creating a Data Plot or Data Sets from a Plotted Function

A function graph displays a curve described by a specified formula. The function graph has no discrete values associated with it. However, you can create a data plot or a worksheet with X and Y data sets from a function graph. To create a worksheet, first create a data plot from the function.

To create a data plot from a function:

1. Right-click on the function and select **Make Dataset Copy of Function** from the shortcut menu. A dialog box opens requesting you enter a Y data set name for the data plot.

It is recommended that you use the following syntax when typing the Y data set name:

WorksheetName_ColumnName

For example, type:

Function_Test1

Should you create a worksheet from the data plot, this notation ensures that the Y column will be properly named.

2. Type the Y data set name, click **OK** to close the dialog box. A FuncCopy graph window opens displaying the data plot derived from your function graph. The data plot contains the number of points specified in the **Density** combination box on the (Plot Details) Function tab.

To create a worksheet from the newly created data plot:

After you create a data plot from your function graph...

1. Right-click on the data plot and select...

Create Worksheet DatasetName

...from the shortcut menu. Origin opens a worksheet displaying the Y data set for the data plot. Origin names the worksheet and Y data set based on the name you specified for the data plot's Y data set (when you created a data plot from the function).

2. To display the data plot's X data set in the worksheet, select **View:Show X Column**.

Changing the Function Formula

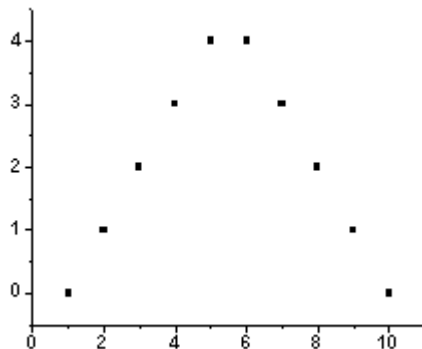
To change the function formula:

1. Double-click on the function in the function graph window to re-open the (Plot Details) **Function** tab.
2. Edit the formula in the **Fn** text box and click **OK** or **Apply**.

The Graph: Types

2D Scatter, Line, and Line + Symbol Graphs

2D Scatter Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Scatter**.

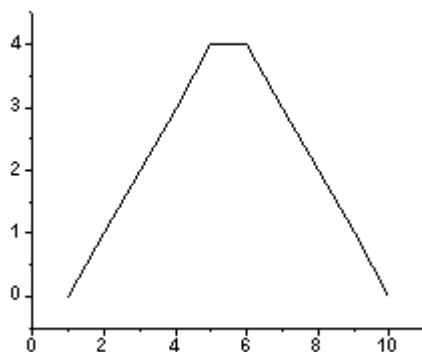
or

2. Click the **Scatter**  button on the 2D Graphs toolbar.

Template

SCATTER.OTP (installed to the Origin program folder).

Line Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Line**.

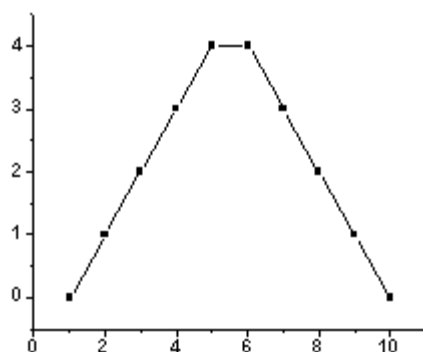
or

2. Click the **Line**  button on the 2D Graphs toolbar.

Template

LINE.OTP (installed to the Origin folder).

Line+Symbol Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Line+Symbol**.

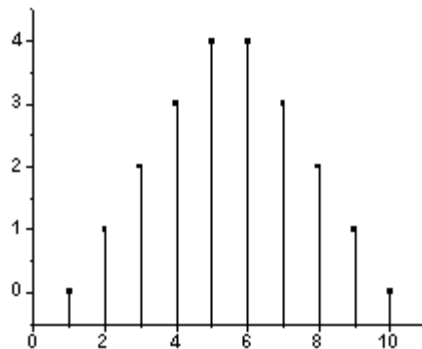
or

2. Click the **Line+Symbol**  button on the 2D Graphs toolbar.

Template

LINESYMB.OTP (installed to the Origin program folder).

Vertical Drop Line Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:Vertical Drop Line**.

or

2. Click the **Vertical Drop Line**  button on the 2D Graphs Extended toolbar.

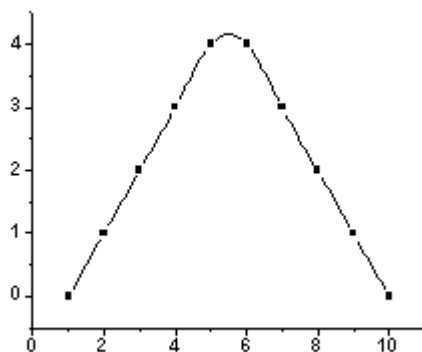
Template

DROPLINE.OTP (installed to the Origin folder).

Notes

This graph type emphasizes the difference in magnitude between data points in a data plot. The data points are displayed as symbols. A vertical line displays from each data point symbol to the X axis.

Spline Connected Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:Spline**.

or

2. Click the **Plot:Special Line/Symbol:Spline**  button on the 2D Graphs Extended toolbar.

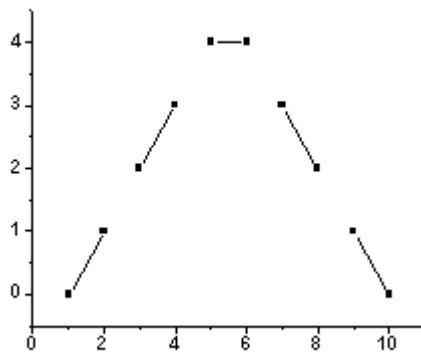
Template

LINESYMB.OTP (installed to the Origin program folder).

Notes

Each data point in the data plot is connected by a line. The line connection type is set to a spline connection on the **Line** tab of the **Plot Details** dialog box (**Format:Plot**). The data points are displayed as symbols.

2 Point Segment Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:2 Point Segment**.

or

2. Click the **Plot:Special Line/Symbol:2 Point Segment**  button on the 2D Graphs Extended toolbar.

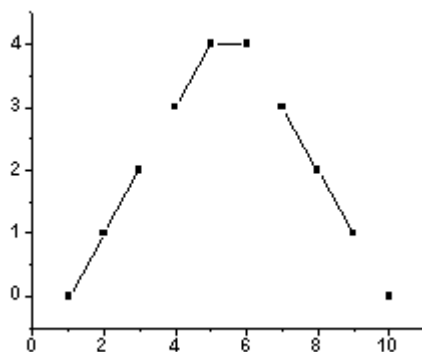
Template

LINESYMB.OTP (installed to the Origin program folder).

Notes

The line connection between points alternates between a straight line and no line (the connection type is set to **Segment** on the **Line** tab of the **Plot Details** dialog box (**Format:Plot**)). Thus, every two consecutive data points are connected by a line (the first and second data points, the third and fourth data points, etc.). The data points are displayed as symbols.

3 Point Segment Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:3 Point Segment**.

or

2. Click the **Plot:Special Line/Symbol:3 Point Segment**  button on the 2D Graphs Extended toolbar.

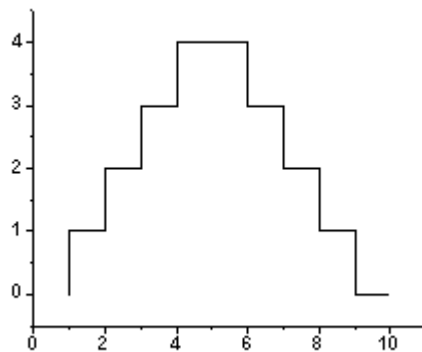
Template

LINESYMB.OTP template located in the Origin folder.

Notes

The line connection display alternates between a straight line for three data points, then no line to the next data point, a straight line for three data points, etc. (the connection type is set to Segment 3 on the Line tab of the Plot Details dialog box (**Format:Plot**)). Thus, every three consecutive data points are connected by two lines (the first, second, and third data points; the fourth, fifth, and sixth data points; etc.). The data points are displayed as symbols.

Vertical Step Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:Vertical Step**.

or

2. Click the **Plot:Special Line/Symbol:Vertical Step**  button on the 2D Graphs Extended toolbar.

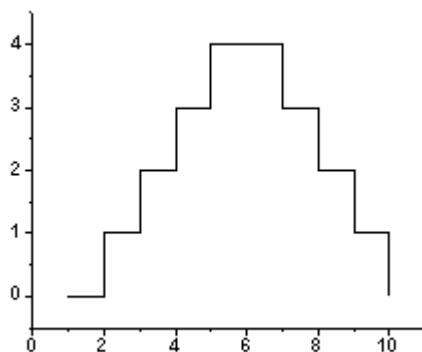
Template

LINE.OTP (installed to the Origin program folder).

Notes

Each data point in the data plot is connected by a line. The line connection type is set to a step vertical connection on the **Line** tab of the **Plot Details** dialog box (**Format:Plot**). The step vertical connection creates a right angle connection between data points, with an initial vertical line. The data points are not displayed.

Horizontal Step Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:Horizontal Step**.

or

2. Click the **Plot:Special Line/Symbol:Horizontal Step**  button on the 2D Graphs Extended toolbar.

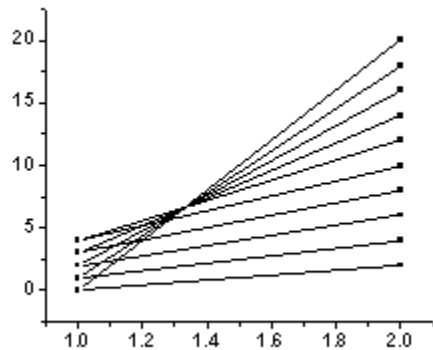
Template

LINE.OTP (installed to the Origin program folder).

Notes

Each data point in the data plot is connected by a line. The line connection type is set to a step horizontal connection on the **Line** tab of the **Plot Details** dialog box (**Format:Plot**). The step horizontal connection creates a right angle connection between data points, with an initial horizontal line. The data points are not displayed.

Line Series Graph




Data Requirements

Select two or three Y columns of values.

Creating the Graph

1. Select required data.
2. Select **Plot:Special Line/Symbol:Line Series**.

or

2. Click the **Line Series**  button on the 2D Graphs Extended toolbar.

Template

LSER2.OTP (two Y columns)

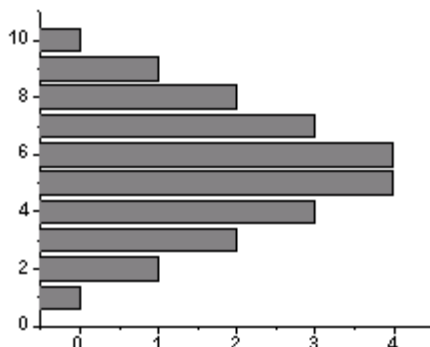
LSER3.OTP (three Y columns)

Notes

After clicking the **Line Series** button, Origin creates a new (hidden) worksheet, **LineSeriesn**. This worksheet includes two columns that contain the selected Y column numbers (1, 2, or 3) and the associated cell values.

2D Bar and Column Graphs

Bar Graph



Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Bar**

or

2. Click the **Bar** button  on the 2D Graphs toolbar.

Template

BAR.OTP (installed to the Origin program folder).

Notes

The Y value of each data point in the data plot is represented as the length of a horizontal bar. Each bar has a fixed width, and each worksheet row of bar values is centered at the associated X value. The X values plot along the vertical axis.

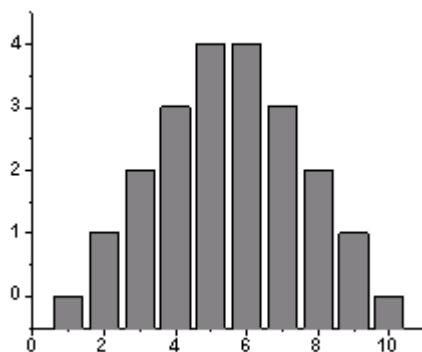
To establish Y=1 as the "floor", or Y value which alters the direction of bar graphs displayed on a logarithmic scale, select the Log Scale use 1 as Floor check box on the Graph tab in the Options dialog box (**Tools:Options**). To display a line when Y=0, select the Bar Graph Show Zero Values check box on the Graph tab of the Options dialog box (**Tools:Options**).

In some cases, disabling **Clip Data to Frame** still results in clipping of data in column/bar graphs.

If this occurs, Clip Data can be defeated by typing the following line of script into the Script Window and pressing ENTER:

```
@CLP = 1
```

Column Graph




Data Requirements

Select one or more Y columns or a range of data from at least one Y column. If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Column**.

or

2. Click the **Column** button  on the 2D Graphs toolbar.

Template

COLUMN.OTP (installed to the Origin program folder).

Notes

The Y value of each data point in the data plot is represented as the height of a column. Each column has a fixed width, and each "X group" of columns is centered at the associated X value.

To establish Y=1 as the "floor", or Y value which alters the direction of column graphs displayed on a logarithmic scale, select the Log Scale use 1 as Floor check box on the Graph tab in the Options dialog box (**Tools:Options**).

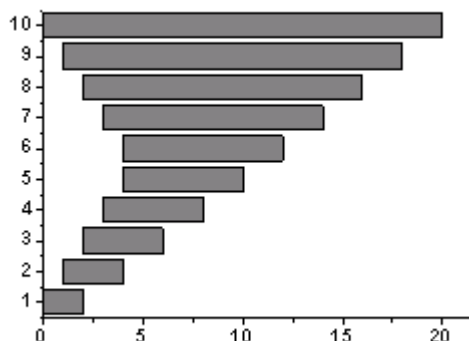
To display a line when Y=0, select the Bar Graph Show Zero Values check box on the Graph tab of the Options dialog box (**Tools:Options**).

In some cases, disabling **Clip Data to Frame** still results in clipping of data in column/bar graphs.

If this occurs, Clip Data can be defeated by typing the following line of script into the Script Window and pressing ENTER:

```
@CLP = 1
```

Floating Bar Graph



Data Requirements

Select at least two Y columns of values (or a range from at least two columns). If there is an X column to the left of the Y columns, the X column values are used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Bar/Column:Floating Bar**

or

2. Click the **Floating Bar**  button on the 2D Graphs Extended toolbar.

Template

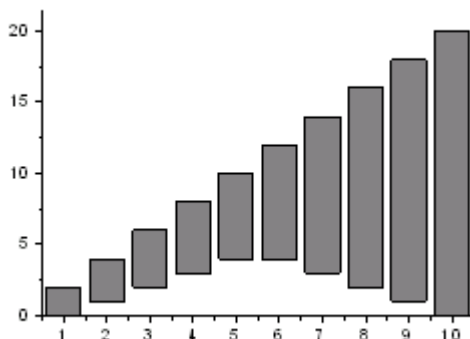
FLOATBAR.OTP (installed to the Origin program folder).

Notes

The floating bar graph displays Y values as beginning, intermediate, and ending bar levels for each X value. The X values plot along the vertical axis.

The first Y data set provides the starting Y position for each bar graph. The second Y data set provides an intermediate level and defines a bar between the starting position and the current position. The third (fourth, etc.) Y data set provides an additional intermediate value and defines a bar between the previous intermediate value and the current value. The final Y data set provides an ending value and defines a bar between the previous intermediate value and the current value.

Floating Column Graph



Data Requirements

Select at least two Y columns of values (or a range from at least two columns). If there is an X column to the left of the Y columns, the X column values are used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Bar/Column:Floating Column**.

or

2. Click the **Floating Column**  button on the 2D Graphs Extended toolbar.

Template

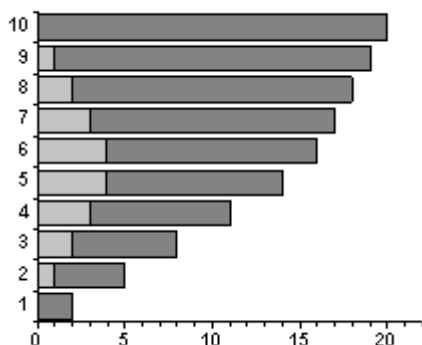
FLOATBAR.OTP (installed to the Origin program folder).

Notes

The floating column graph displays Y values as beginning, intermediate, and ending column levels for each X value.

The first Y data set provides the starting Y position for each column graph. The second Y data set provides an intermediate level and defines a column between the starting position and the current position. The third (fourth, etc.) Y data set provides an additional intermediate value and defines a column between the previous intermediate value and the current value. The final Y data set provides an ending value and defines a column between the previous intermediate value and the current value.

Stack Bar Graph




Data Requirements

Select at least one Y column of values (or a range from at least one column). If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Bar/Column:Stack Bar**

or

2. Click the **Stack Bar**  button on the 2D Graphs Extended toolbar.

Template

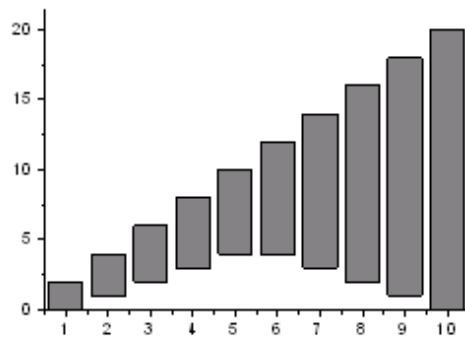
BAR.OTP (installed to the Origin program folder).

Notes

For each X value, the associated Y values are represented as the length of a bar. Each bar has a fixed width. The bars, however, are stacked on each other so that the second bar segment begins at the end of the first bar, etc. The stack of bars is centered at the associated X value. The X values plot along the vertical axis. To unstack the bars, select **Graph:Stack Grouped Data in Layer** (to de-select the menu command).

To display a line when Y=0, select the Bar Graph Show Zero Values check box on the Graph tab of the Options dialog box (**Tools:Options**).

Stack Column Graph




Data Requirements

Select at least one Y column of values (or a range from at least one column). If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Bar/Column:Stack Column**.

or

2. Click the **Stack Column**  button on the 2D Graphs Extended toolbar.

Template

COLUMN.OTP (installed to the Origin program folder).

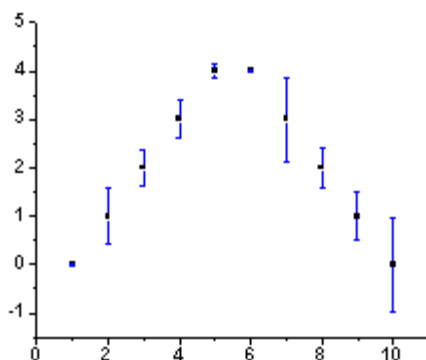
Notes

For each X value, the associated Y values are represented as the height of a column. Each column has a fixed width. The columns, however, are stacked on each other so that the second column begins at the end of the first column, etc. The stack of columns is centered at the associated X value. To unstack the columns, select **Graph:Stack Grouped Data in Layer** (to de-select the menu command).

To display a line when Y=0, select the Bar Graph Show Zero Values check box on the Graph tab of the Options dialog box (**Tools:Options**).

2D Graphs with Error Bars

Y Error Bar Graph



Data Requirements


Select two Y columns or a range of data from two Y columns. The left-most Y column supplies the Y values, the rightmost column supplies the Y error bar values.

If the Y columns have an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:Y Error**.

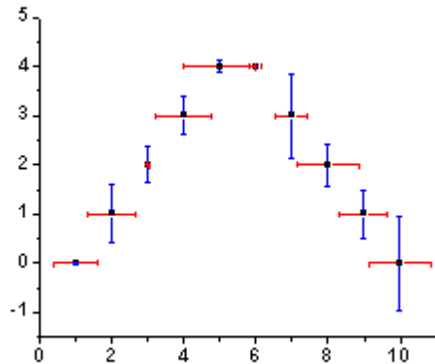
or

2. Click the **Y Error**  button on the 2D Graphs Extended toolbar.

Template

ERRBAR.OTP (installed to the Origin program folder).

XY Error Bar Graph



Data Requirements


Select three Y columns or a range of data from three Y columns. The left-most Y column supplies the Y values, the middle column supplies the X error bar values and the rightmost column supplies the Y error bar values.

If the Y columns have an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Special Line/Symbol:XY Error**.

or

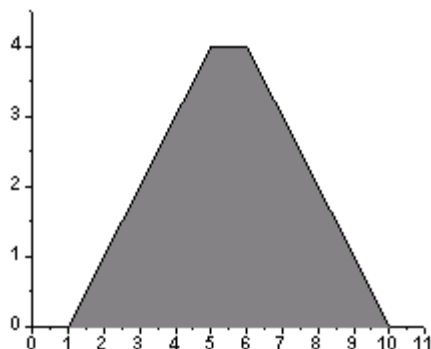
2. Click the **XY Error**  button on the 2D Graphs Extended toolbar.

Template

ERRBAR.OTP (installed to the Origin program folder).

Area, Polar, and 2D Waterfall Graphs

Area Graph



Data Requirements

Select at least one Y column of values (or a range from at least one column). If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:Area**

or

2. Click the **Area**  button on the 2D Graphs toolbar.

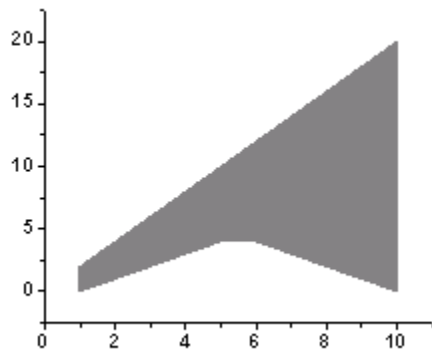
Template

AREA.OTP (installed in the Origin program folder).

Notes

When one Y column of values (or a range from one column) is selected, the area between the data plot and the "From" Y axis value is filled by default. When more than one Y column of values (or a range from more than one column) is selected, each successive column of values displays as an area graph that is stacked on the previous area graph. Thus, the upper bounds of the previous area graph becomes the baseline of the next area graph. To plot each of the data plots so that the area between the data plot and the "From" Y axis value is filled, select **Graph:Stack Grouped Data in Layer** (to de-select this command).

Fill Area Graph



Data Requirements

Select two Y columns of values (or a range from two columns). If there is an X column to the left of the Y columns, the X column values are used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, select **Plot:Fill Area**.

or

2. Click the **Fill Area**  button on the 2D Graphs toolbar.

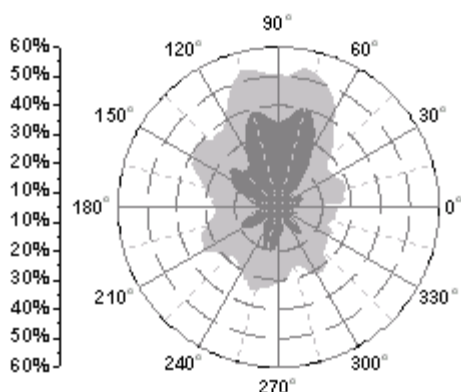
Template

FILLAREA.OTP (installed to the Origin program folder).

Notes

The area between the data plots (the two Y columns) is filled.

Polar Graph



Data Requirements

Select at least one Y column (or a range from at least one Y column). If the Y column(s) has an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:Polar**.

or

2. Click the **Polar**  button on the 2D Graphs toolbar.

Template

POLAR.OTP (installed to the Origin program folder).

Note: To learn more polar graphs, review the POLAR.OPJ project located in your Origin \SAMPLES\GRAPHING\2D PLOTS folder.

Notes

The polar graph plots radial position (Y) versus the angular value (X). Units are in degrees.

The graph window has three buttons:

- Click **Set Angular Range** to modify the starting and ending angular values, as well as the increment.
- Click **90 ← 0** to set the first angular value at "3 o'clock" and increment counterclockwise.
- Click **0 → 90** to set the first angular value at "12 o'clock" and increment clockwise.

Select **Fixed from 0** to display the polar graph with the center of the graph representing a Y value of 0. Select **Use Y-Axis Range** to display the polar graph with the center of the graph representing the Y axis scale "From" text box value (on the Scale tab of the Axis dialog box).

To Modify the Angular Range

1. Click **Set Angular Range** to open the Angular Range dialog box.

2. Specify the starting and ending angular values, as well as the angular increment.

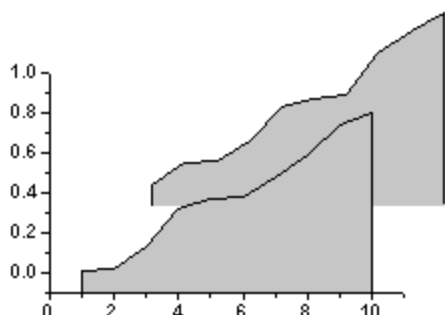
To Modify the Circular Grids

1. Select **Format:Axes:Y Axis** to open the Y Axis dialog box.
2. Select the **Grid Lines** tab. **Horizontal** is the active selection in the **Selection** list box. Horizontal grids are equivalent to circular grids in a polar graph. To customize the circular grids, make modifications to this tab when Horizontal is selected from the Selection list box.

To Modify the Radial Grids

1. Select **Format:Axes:X Axis** to open the X Axis dialog box.
2. Select the **Grid Lines** tab. Vertical is the active selection in the Selection list box. Vertical grids are equivalent to radial grids in a polar graph. To customize the radial grids, make modifications to this tab when Vertical is selected from the Selection list box.

2D Waterfall Graph




Data Requirements

Select at least one Y column (or a range from at least one Y column). Ideally, select at least two Y columns (or a range of at least two Y columns). If the Y column(s) has an associated X column, the X column supplies the X values; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Special Line/Symbol:Waterfall**

or

3. Click the **Waterfall**  button on the 2D Graphs Extended toolbar.

Template

WATERFAL.OTP (installed to the Origin program folder).

Notes

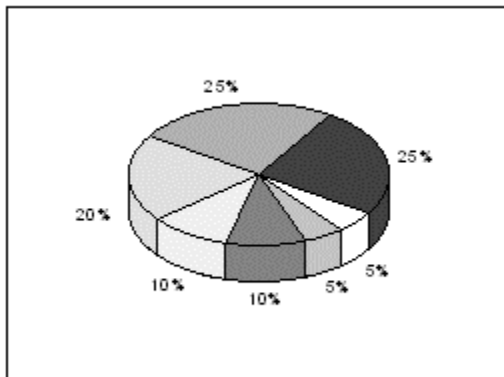
The waterfall graph is ideal for comparing variations between multiple data sets created under similar conditions. The graph has a pseudo-3D effect, enabling you to see variations in the Z direction. Each data set is displayed as a line data plot which is offset by a specified amount in both the X and Y direction. To adjust the data plot offset, click the **Offset Amount** button in the graph window. This action opens a dialog box in which you control the offset. Select or clear the offset from the **XY Offset** drop-down list. Specify the Y offset in the **Total Y Offset (%)** text box. Specify the X offset in the **Total X Offset (%)** text box.

Click the **Reverse Order** button in the graph window to switch the order in which the data sets are plotted. Thus, the first data set is plotted last, the last data set is plotted first, etc., providing a different perspective on data set relations.

To fill the area below each line data plot, click the **Fill Area** button in the graph window. This action opens a dialog box in which you control the fill display. Select the **Enable Fill** check box to fill the area beneath the data plot with the color specified from the **Fill with Color** drop-down list. Select the **Side Lines** check box to display vertical drop lines at the first and last data points in each of the data plots (using the specified fill color).

Note: You can also control the fill from the Plot Details dialog box.

Pie Charts



Data Requirements

Select exactly one Y column of values (or a range from one column).

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Pie**

or

2. Click the **Pie Chart**  button on the 2D Graphs toolbar.

Template

PIE.OTP (installed to the Origin program folder).

Note: To learn more about pie charts, review the 3D PIE CHART.OPJ project located in your Origin \SAMPLES\GRAPHING\3D PLOTS folder.

Notes

The selected values are summed, and the percentage of the total is determined for each selected value. The pie chart displays the percentage of the total for each selected value as a pie section.

To remove the rectangular frame from the pie chart:

1. From the menu, select **Format:Layer**.
2. Select the **Display** tab and clear **X Axes** and **Y Axes** in the **Show Elements** group.
3. Click **Apply** or **OK**.

Smith Charts

Data Requirements

Requires a selection of at least one Y column of values (or a range from at least one column). If the Y column(s) has an associated X column, then the X column supplies the X values. Otherwise, the worksheet's default X values are used.

Creating the Graph

Select **Plot:Smith Chart** or click the Smith Chart button on the 2D Graphs toolbar.

Template

The Smith Chart graph is created from the SMITHCHT.OTP template located in the Origin folder.

Notes

To customize the Smith Chart, edit the Plot Details and Axes dialog boxes. Additionally, click the



button to open the Smith Chart tool.

The Normalization Group

Re-normalize the current Smith Chart by entering or selecting a factor from the Factor combo box. Click Normalize to perform the normalization.

The Current Active Data Set Group

If you have plotted multiple data sets into the Smith Chart, the "Convert Data to Mag / Angle" and the "Reinterpret Data as Mag / Angle" buttons act on the *active* data plot. You can change the active data plot in the Smith Chart from the **Data** menu or by selecting the data plot icon in the legend. To update the Smith Chart tool with this change, click the Update button on the tool. (Note: R = real part, X = imaginary part)

The "Convert Data to Mag / Angle" Button

Click this button to convert the active data plot into the Mag / Angle format and put the data in the source worksheet.

The "Reinterpret Data as Mag / Angle" Button

Click this button to treat the active data plot as the Mag / Angle format, and convert the data into R / X format. The data is then re-plotted.

The "Reverse R Axis" Button

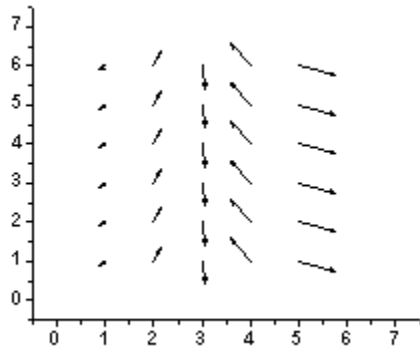
Click this button to reverse the real part axis of the Smith Chart.

The Constant SWR Circle Group

Given the point position specified, select the circle point density and the line color. Click the Add button to add a constant SWR circle through the given point.

Vector Graphs

X, Y, Angle, Magnitude Vector Graph



Data Requirements

Select three Y columns (or a range from three Y columns). If there is an X column to the left of the Y columns, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:Vector XYAM**.

or

2. Click the **Vector XYAM**  button on the 2D Graphs toolbar.

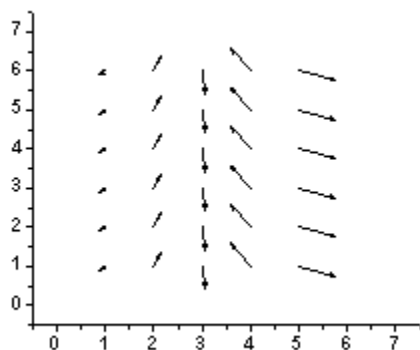
Template

VECTOR.OTP (installed to the program folder).

Notes

The leftmost Y column controls the Y coordinate of the vector tail (by default). The second Y column determines the angle of the vector. The angle is measured counterclockwise from a line parallel to the X axis, bisecting the vector. The third Y column controls the vector length in units of points. The Plot Details dialog box provides a control to scale the length of the vector (**Format:Plot**).

X, Y, X, Y Vector Graph




Data Requirements

Select two X columns and two Y columns (or a range from these columns).

Creating the Graph

1. Select required data.
2. Select **Plot:Vector XYXY**.

or

2. Click the **Vector XYXY**  button on the 2D Graphs toolbar.

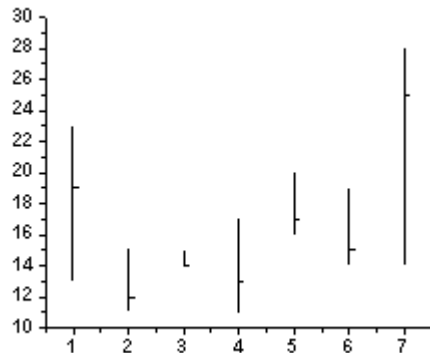
Template

VECTXYXY.OTP (installed to the Origin program folder).

Notes

The leftmost X and Y columns determine the XY coordinate of the tail of the vector. The second set of X and Y columns determine XY coordinate of the head of the vector.

High-Low-Close Charts



Data Requirements

Select exactly three Y column of values (or a range from three columns). The leftmost Y column contains the high values, the middle Y column displays the low values, and the rightmost Y column displays the closing values. If there is an X column to the left of the Y columns, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:High-Low-Close**.

or

3. Click the **High-Low-Close**  button on the 2D Graphs toolbar.

Template

HLCLOSE.OTP (installed to the Origin program folder).

Notes

The chart displays the high and low Y values for a given X value. These values are connected by a vertical line (the data points aren't displayed). The close Y value for a given X value displays as a tick mark on the vertical line.

Statistical Graphs

Creating Histograms

A histogram displays the number of times a data value in a selected column fell within a specified bin.

To create a histogram:

1. Highlight one or more Y worksheet columns (or a range from one or more Y columns).
2. Select **Plot:Statistical Graphs:Histogram**.

Origin automatically calculates the bin size and creates a new graph from the HISTGM.OTP template. The binned data is saved in a **Binn** worksheet. This worksheet contains the bin X values, counts, cumulative sum, and percentages.

To access the **Binn** worksheet:

1. Right-click on the histogram and select **Go to Bin Worksheet** from the shortcut menu.

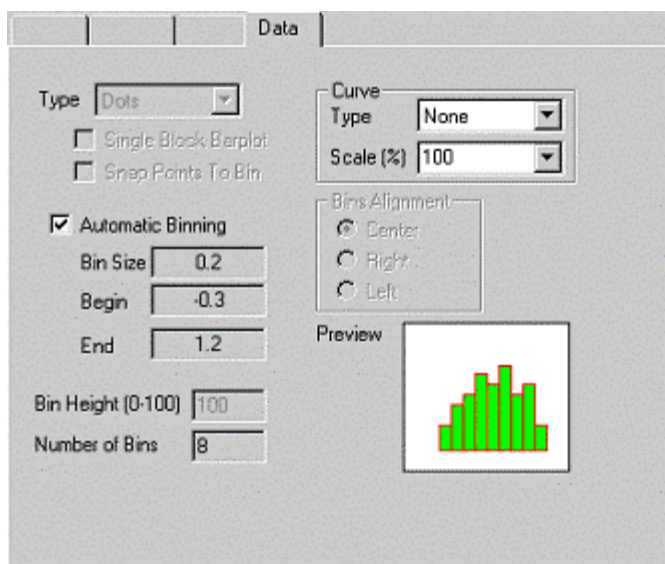
To customize the histogram:

To customize the histogram display:

1. Double-click on the histogram, or right-click and select **Plot Details**.

Both actions open the Plot Details dialog box with the histogram data plot icon active on the left side of the dialog box. The histogram controls are available on tabs on the right side of the dialog box. Binning behavior is determined by controls on the **Data** tab. Note that *some* Data tab controls are relevant only to the Box Chart (which shares controls on this tab with the histogram).

The (Plot Details) Data Tab Controls



Edit the bin limits by:

1. Clearing the **Automatic Binning** check box.

2. Edit the **Bin Size**, and the **Begin** and **End** values.

To overlay a distribution curve on the binned data (the histogram):

1. Select **Normal**, **Lognormal**, **Poisson**, **Exponential**, **Laplace**, or **Lorentz** from the **Type** drop-down list. The **Preview** window displays your selection.

Note that curves selected from the Type drop-down list are not "fitted" to your data. Instead, Origin looks for the mean of the data, then overlays the curve, placing the mean at the same location. If the curve is a two parameter curve, Origin takes into account the standard deviation of the curve.

The **Scale** combination box controls the curve's use of the drawing space in the X direction; for instance, if you select 100 from the drop-down list, then all the drawing space in the X direction will be used (the curve will be wider). If you have 50 selected, then the curve will only take up half of the allocated drawing space (the curve will be narrower).

To create a histogram with probabilities:

To create a histogram with probabilities:

1. Highlight a single worksheet column (or a range from a worksheet column) and select **Plot:Statistical Graphs:Histogram + Probabilities**.

This menu command is nearly identical to the **Histogram** menu command, except that the template invoked by this command (HISTCUMU.OTP) also displays a cumulative sum of the data (layer 2).

Additionally, the **Histogram + Probabilities** menu command types the statistical results -- the mean, the standard deviation, the maximum and minimum values, and the total number of values -
- to the Results Log.

Note: The **Histogram** menu command plots each selected data set in the same layer. The **Stacked Histograms** menu command (**Plot:Statistical Graphs:Stacked Histograms**) plots each selected data set in its own layer (using the same bin limit for each layer).

To learn more about histograms, review the HISTOGRAM.OPJ project located in your Origin \SAMPLES\GRAPHING\STATISTICAL GRAPHS folder.

Creating Box Charts

To create a box chart, highlight one or more Y worksheet columns (or a range from one or more Y columns) and select **Plot:Statistical Graphs:Box Chart**.

Each Y column of data is represented as a separate box. The column names or labels supply the X axis tick labels. By default, the box is determined by the 25th and 75th percentiles. The whiskers are determined by the 5th and 95th percentiles.

Note: To learn more about box charts, review the BOX CHART.OPJ project located in your Origin \SAMPLES\GRAPHING\STATISTICAL GRAPHS folder.

Customizing the Box Chart

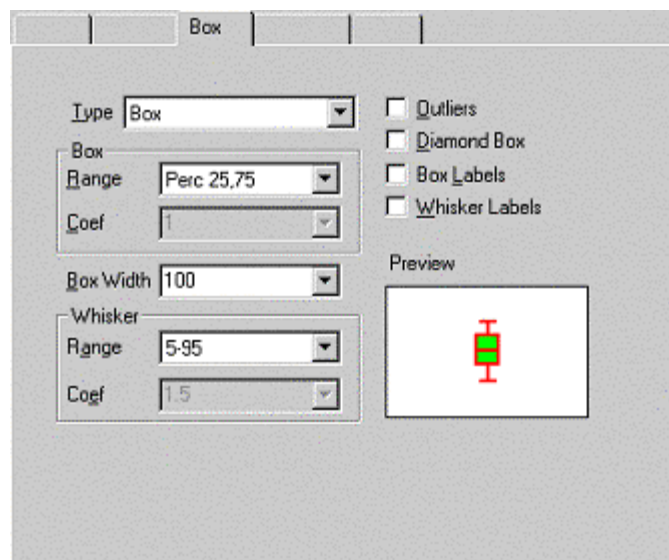
To customize the box chart display:

1. Double-click on the box chart.

or

1. Right-click and select **Plot Details**. Both actions open the Plot Details dialog box with the box chart data plot icon active on the left side of the dialog box. The box chart controls are available on tabs on the right side of the dialog box.

The **Box** Tab on the Plot Details Dialog Box



By default, the box chart displays only the box - not the binned data. You can, however, display the box and binned data, or only the binned data. The binned data is saved in a **Binn** worksheet. This worksheet contains the bin X values, counts, cumulative sum, and percentages.

To access the **Binn** worksheet:

1. Right-click on the box chart and select **Go to Bin Worksheet** from the shortcut menu.

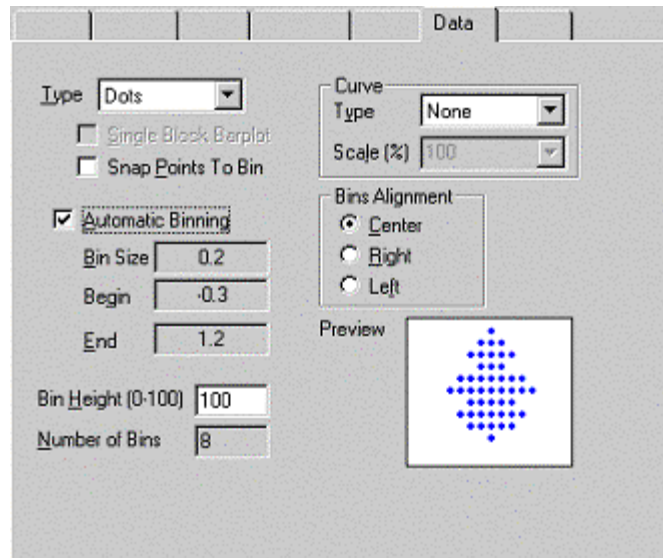
To display the binned data with the box chart, or only the binned data, select the desired display from the **Type** drop-down list. When you select a display that includes the

binned data, the Plot Details **Data** tab becomes available for editing the bins and overlaying a distribution curve.

The **Box** group and the **Whiskers** group control the display of the box and whiskers. Select the desired percentiles or other values to represent the box or whiskers.

Outliers, diamond box, and box and whisker labels are activated by selecting the associated check boxes on the **Box** tab.

The **Data** Tab on the Plot Details Dialog Box



The **Data** tab is available when you select a box chart display that includes the binned data from the **Type** drop-down list on the **Box** tab. Edit this tab to control the display of binned data.

Select **Dots**, **Bars**, or **Dots and Bars** from the **Type** drop-down list. Dots shows the individual binned data points and bars shows a histogram-like representation of the data, with bars of the specified bin size.

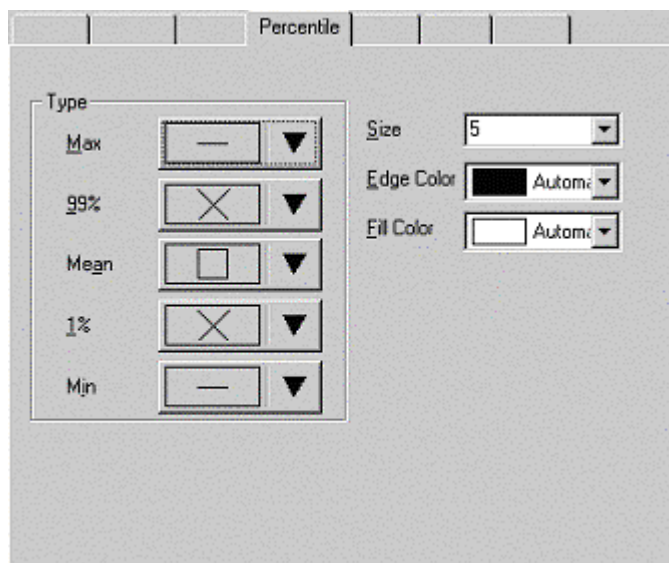
Select the **Single Block Bar Plot** check box to remove the lines between bins when **Bars** is selected from the **Type** drop-down list. Select the **Snap Points to Bin** check box to align the binned data points horizontally in the bins.

Edit the bin limits by clearing the **Automatic Binning** check box and editing the associated text boxes.

Overlay a distribution curve on the binned data by selecting **Normal**, **Lognormal**, **Poisson**, **Exponential**, **Laplace**, or **Lorentz** from the **Type** drop-down list. The Preview window displays your selection.

Curves selected from the Type drop-down list are not "fitted" to your data. Instead, Origin determines the data mean, then overlays the curve so that means coincide. If it is a two parameter curve, Origin takes into account the standard deviation of your data.

The **Scale** combination box in the Curve group controls use of the drawing space in the X direction. For instance, if you have 100 selected from this drop-down list, then all the drawing space in the X direction will be used (the curve will be wider). If you have 50 selected, then the curve will only use half of the allocated drawing space (the curve will be narrower).

The **Percentile** Tab on the Plot Details Dialog Box

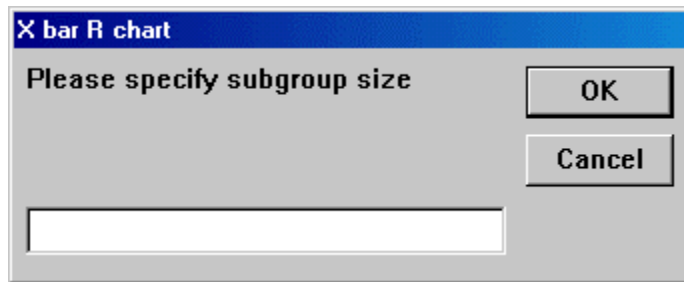
The **Percentile** tab provides controls for customizing the symbols for various percentiles in the box chart. Click the down arrow next to the symbol you want to change. Select the desired symbol from the symbol gallery that opens.

Creating QC Charts

QC charts are used to study the fluctuation of data in a continuous process.

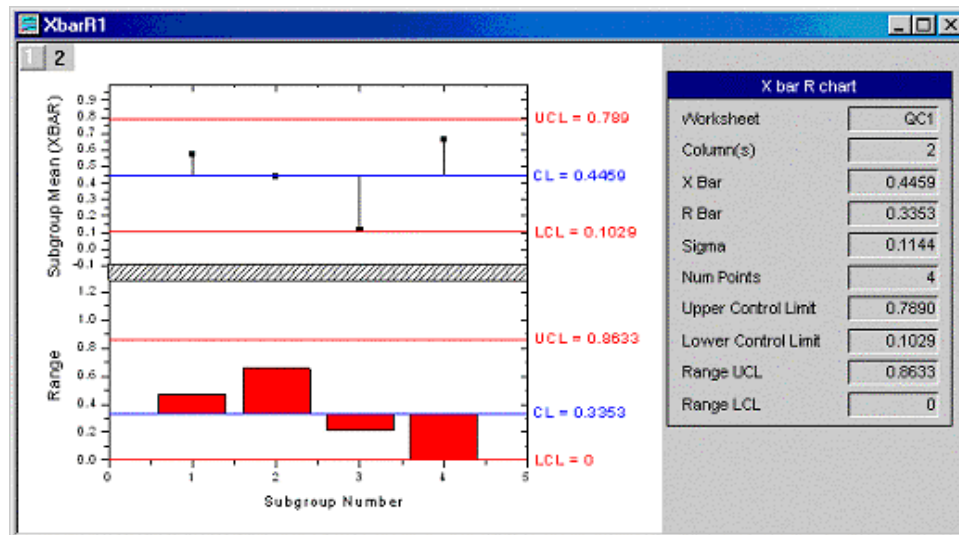
To create a QC chart

1. Highlight at least one column of values (or a range from at least one column) and select **Plot:Statistical Graphs:QC (X bar R) Chart**. Origin opens the **X bar R Chart** dialog box.



2. Specify the subgroupsize for the selected data set.

Origin creates a worksheet and graph window displaying two layers. The worksheet contains the mean, range, and standard deviation for each subgroup in the selected data set.

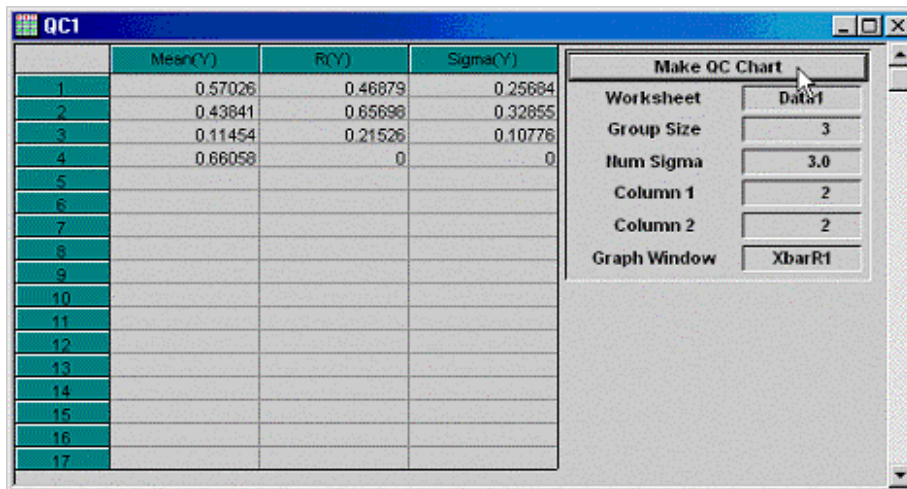


The upper layer of the QC chart is the X bar graph. This layer displays the mean value for each of the subgroups as a scatter graph with drop lines to the average of the mean for each group (X bar). This layer also displays two limit lines that are positioned *Num Sigma* standard deviations away from the X bar. *Num Sigma* is defined in the QC1 worksheet window and is three by default.

The lower layer of the QC chart is the R chart. This layer displays the range for each of the subgroups as a column graph. The range for each of the subgroups is plotted from the average line (or R bar). This line represents the groups average range, or the average of the mean range within each subgroup. This layer also displays two limit lines - the UCL and LCL lines. For information on the calculations for the UCL and LCL lines, see "Statistical Quality Control" 5th edition (1980) by Grant, E.R. and Leavenworth, R.S., McGraw Hill, pg 81.

To create a *new* QC chart based on the original worksheet

Edit the desired text boxes in the **QC1** worksheet, then click the **Make QC Chart** button.



To display *multiple* QC charts, type a new window name in the **Graph Window** text box.

To Create a QC Chart from Multiple Data Sets

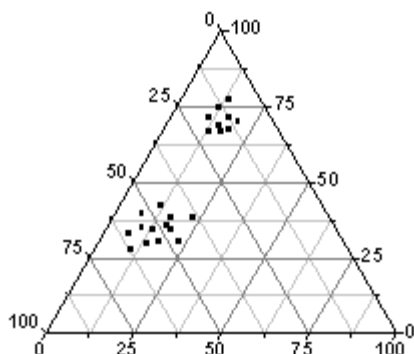
To create a QC chart from more than one data set in the worksheet:

1. Highlight the desired worksheet columns and select **Plot:Statistical Charts:QC (X bar R) Chart**.

An Attention dialog box informs you that a group is defined for each row, which extends over the selected column range.

Note: To learn more about QC charts, review the QC.CHART.OPJ project located in your Origin \SAMPLES\GRAPHING\STATISTICAL GRAPHS folder.

Ternary Graphs




Data Requirements

Select one Z column of values (or a range from one Z column). The worksheet must also contain Y column values (and typically X column values). If there is an X column to the left of the Y column, the X column values are used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Ternary**.

or

2. Click the **Ternary**  button on the 2D Graphs toolbar.

Template

TERNARY.OTP (installed to the Origin program folder).

Note: To learn more about the ternary diagram, review the TERNARY.OPJ project located in your Origin \SAMPLES\GRAPHING\2D PLOTS folder.

Notes

Ternary diagrams are used to represent the relative percentages (default is expressed as decimal) of three components (X, Y, and Z). Each worksheet row of X, Y, and Z values determines a data point in the ternary diagram.

- Values for the Y component are read from 0.00 at the lower-right corner of the triangle, to 1.00 at the peak of the triangle.
- Values for the Z component are read from 1.00 at the lower-left corner of the triangle, to 0.00 at the peak of the triangle.
- Values for the X component are read from 0.00 at the lower-left corner of the triangle to 1.00 at the lower-right corner of the triangle.

When plotting XYZ data as a ternary diagram, Origin assumes that each row of X, Y, and Z values are *normalized* (so that $X+Y+Z = 1$). If your data are not normalized, Origin

will do this for you. When you normalize your worksheet data for the ternary diagram, the **Data Reader** tool reads *the actual X, Y, and Z worksheet values* in the diagram.

To display the axis scales in percentages (0% to 100%):

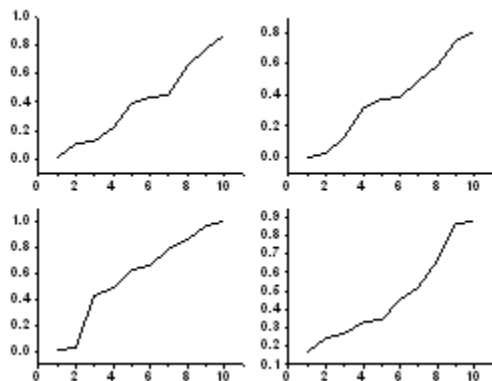
1. From the menu, choose **Format:Axis Tick Labels:Axis...**
2. On the **Tick Labels** tab, specify a **Divide By Factor** of **0.01**.
3. Click **Apply** or **OK**.

To display data points outside of the plot axes:

1. Click on your ternary graph to activate the graph window.
2. Choose **Format: Layer** from the menu.
3. Select the **Display** tab.
4. In the **Data Drawing Options** group, select **Show Points Outside Triangle**.

Multiple Layer Graphs

4 Panel Graph




Data Requirements

Select at least one Y column of values (or a range from at least one column). Ideally, select four Y columns of values. If the Y column(s) has an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:Panel:4 Panel**.

or

2. Click the **4 Panel**  button on the 2D Graphs Extended toolbar.

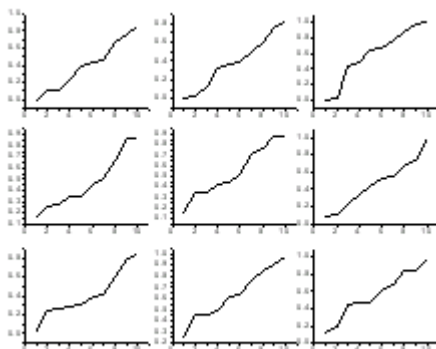
Template

PAN4.OTP (installed to the Origin program folder).

Notes

Each column of Y values plots into a separate layer. The layers are arranged in two columns by two rows.

9 Panel Graph




Data Requirements

Select at least one Y column of values (or a range from at least one column). Ideally, select nine Y columns of values. If the Y columns have an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:Panel:9 Panel**.

or

2. Click the **9 Panel**  button on the 2D Graphs Extended toolbar.

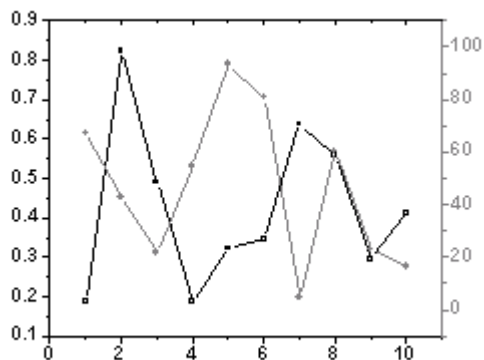
Template

PAN9.OTP (installed to the Origin program folder).

Notes

Each column of Y values plots into a separate layer. The layers are arranged in three columns by three rows.

Double Y Axis Graph



Data Requirements

Requires a selection of at least two Y columns (or a range from at least two columns). If there is an X column to the left of the Y columns, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select the required data.
2. Select **Plot:Special Line/Symbol:Double Y**

or

2. Click the **Double Y Axis**  button on the 2D Graphs Extended toolbar.

Template

DOUBLEY.OTP (installed to the Origin program folder).

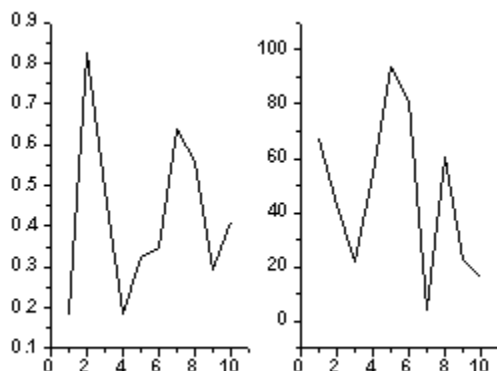
Notes

The double Y axis graph contains two layers:

- Layer 2 is linked to layer 1.
- The X axis in layer 2 has a straight one-to-one link with the X axis in layer 1.

If two columns of values are selected (or a range of two columns), then one data plot displays in each layer. Each data point in the data plot is connected by a line. The default line connection between points is a straight line. The data points are displayed as symbols.

Horizontal 2 Panel Graph



Data Requirements

Select at least one Y column of values (or a range from at least one column). Ideally, select two Y columns of values. If the Y columns have an associated X column, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select the required data.
2. From the menu, select **Plot:Panel:Horizontal 2 Panel**.

or

2. Click the **Horizontal 2 Panel**  button on the 2D Graphs Extended toolbar.

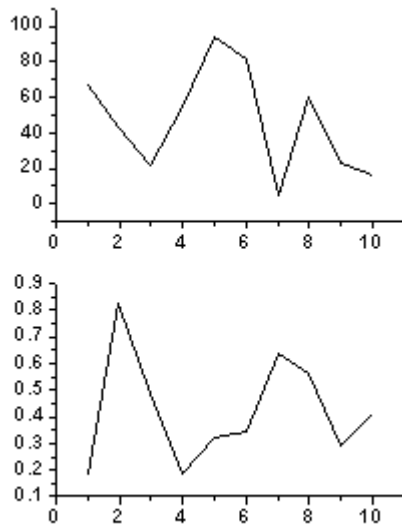
Template

PAN2HORZ.OTP (installed to the Origin program folder).

Notes

Each column of Y values plots into a separate layer. The two layers are arranged in two columns by one row.

Vertical 2 Panel Graph



Data Requirements

Select at least one Y column of values (or a range from at least one column). Ideally, select two Y columns of values. If the Y columns have an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Panel:Vertical 2 Panel**.

or

2. Click the **Vertical 2 Panel**  button on the 2D Graphs Extended toolbar.

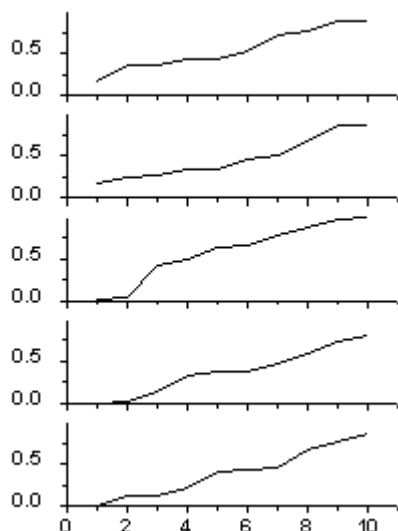
Template

PAN2VERT.OTP (installed to the Origin program folder).

Notes

Each column of Y values plots into a separate layer. The two layers are arranged in one column and two rows.

Stack Graph




Data Requirements

Select at least one Y column (or a range from at least one Y column). Ideally, select at least two Y columns (or a range of at least two Y columns). If the Y columns have an associated X column, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:Panel:Stack**.

or

1. Click the **Stack**  button on the 2D Graphs Extended toolbar.

Template

STACK.OTP (installed to the Origin program folder).

Notes

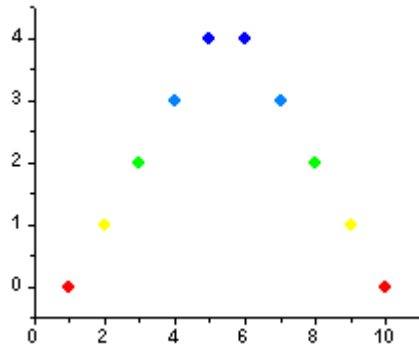
Each data plot displays in its own layer in a graph window. The layers are stacked in one column. The leftmost selected data set in the worksheet displays in the lower graph layer (layer 1). The data set to the right of the leftmost data set in the worksheet displays in layer 2, etc. Each child layer is linked to layer 1. Additionally, the X axis in each child layer has a straight one-to-one link with the X axis in layer 1.

The Y axis titles display the associated worksheet column names. No tick labels or X axis titles display.

Each data point in the data plot is connected by a line.

Indexed Size (Bubble) and Color Mapped Graphs

Color Mapped Graph




Data Requirements

Select two Y columns of values (or a range from two Y columns). If there is an X column to the left of the Y columns, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Bubble/Color Mapped:Color Mapped**

or

2. Click the **Color Map**  button on the 2D Graphs Extended toolbar.

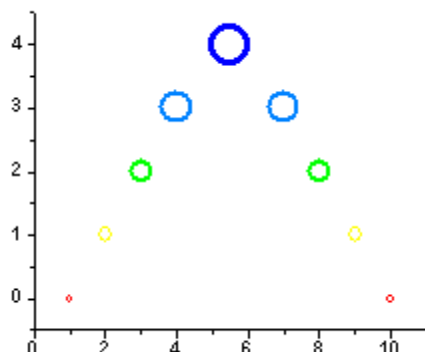
Template

SCATTER.OTP (installed to the Origin program folder).

Notes

For each row, the two Y column values determine the display of the data point. The leftmost Y column provides the Y data point values. The second Y column controls the data point symbol color. Origin finds the minimum and maximum values in the second Y column, creates eight evenly sized ranges of values between the minimum and maximum values, and then associates a color with each range of values. Each data point color is determined by finding the color associated with the second Y column value in the color map.

Indexed Size (Bubble) and Color Map Graph



Data Requirements

Select three Y columns of values (or a range from three Y columns). If there is an X column to the left of the Y columns, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Bubble/Color Mapped:Bubble + Color Mapped**.

or

2. Click the **Bubble + Color Mapped**  button on the 2D Graphs Extended toolbar.

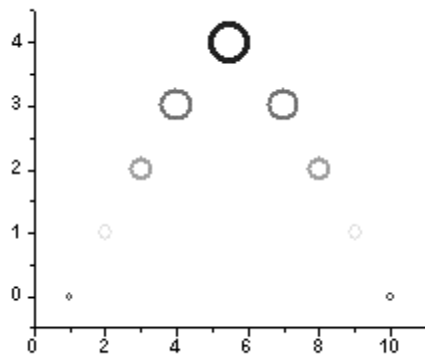
Template

SCATTER.OTP (installed to the Origin program folder).

Notes

For each row, the three Y column values determine the display of the data point. The leftmost Y column provides the Y data point values. The second Y column controls the data point symbol size in units of points. The third Y column controls the symbol color. Origin finds the minimum and maximum values in the third Y column, creates eight evenly sized ranges of values between the minimum and maximum values, and then associates a color with each range of values. Each data point color is determined by finding the color associated with the third Y column value in the color map.

Indexed Size (Bubble) Graph




Data Requirements

Select two Y columns of values (or a range from two Y columns). If there is an X column to the left of the Y columns, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:Bubble/Color Mapped:Bubble**.

or

2. Click the **Bubble**  button on the 2D Graphs Extended toolbar.

Template

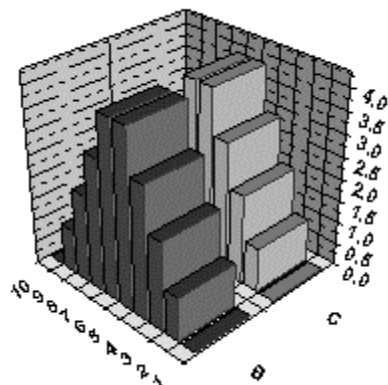
SCATTER.OTP (installed to the Origin program folder).

Notes

For each row, the two Y column values determine the display of the data point. The first Y column provides the Y data point values. The second Y column controls the data point symbol size in units of points.

3D XYY Graphs

3D Bar Graph



Data Requirements

Select at least one Y column (or a range from at least one Y column). Ideally, select at least two Y columns (or a range of at least two Y columns). If the Y columns have an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:3D XYY:3D Bars**.

or

2. Click the **XYY 3D Bars**  button on the 3D Graphs toolbar.

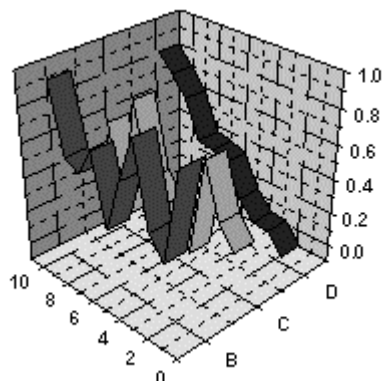
Template

BAR3D.OTP (installed to the Origin program folder).

Notes

The Y value of each data point is represented as the height of a column. Each column has a fixed width and is labeled with its worksheet column name on the Z axis.

Ribbon Graph



Data Requirements

Select at least one Y column (or a range from at least one Y column). Ideally, select at least two Y columns (or a range of at least two Y columns). If the Y column(s) has an associated X column, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:3D XYY:3D Ribbons**.

or

2. Click the **3D Ribbons**  button on the 3D Graphs toolbar.

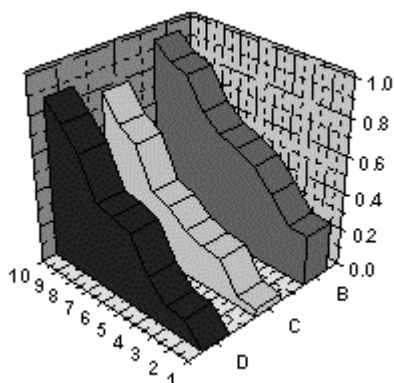
Template

RIBBON.OTP (installed to the Origin program folder).

Notes

The Y value of each data point is represented as the height of a ribbon. Each ribbon has a fixed width, and is labeled with its worksheet column name on the Z axis.

Wall Graph



Data Requirements

Select at least one Y column (or a range from at least one Y column). Ideally, select at least two Y columns (or a range of at least two Y columns). If the Y column(s) has an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

Select **Plot:3D XYY:3D Walls** or click the **3D Walls**  button on the 3D Graphs toolbar.

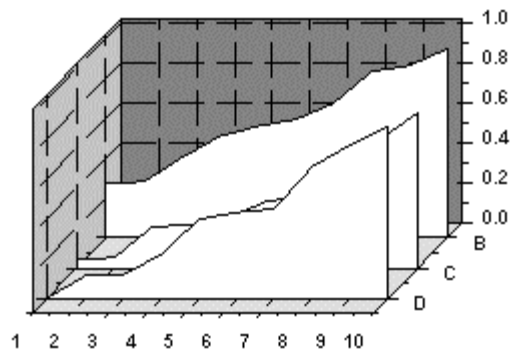
Template

The 3D walls graph is created from the WALLS.OTP template located in the Origin folder.

Notes

The Y value of each data point is represented as the height of a wall. Each wall has a fixed width, and is labeled with its worksheet column name on the Z axis.

3D Waterfall Graph



Data Requirements

Select at least one Y column (or a range from at least one Y column). Ideally, select at least two Y columns (or a range of at least two Y columns). If the Y column(s) has an associated X column, the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:3D XYY:3D Waterfall**.

or

2. Click the **3D Waterfall**  button on the 3D Graphs toolbar.

Template

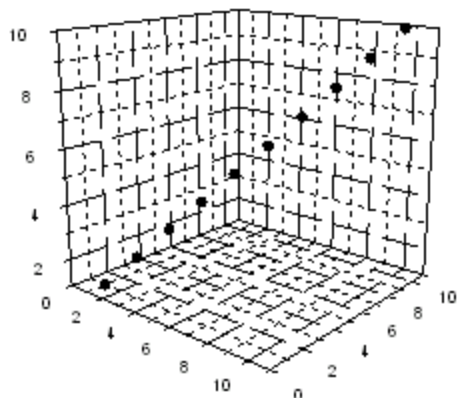
WATER3D.OTP (installed to the Origin program folder).

Notes

The Y values in each column define an XY face with white fill color.

3D XYZ Graphs

3D Scatter Graph



Data Requirements

Select one Z column (or a range from one Z column). If the Z column has an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. Select **Plot:3D XYZ:3D Scatter**.

or

2. Click the **3D Scatter Plot**  button on the 3D Graphs toolbar.

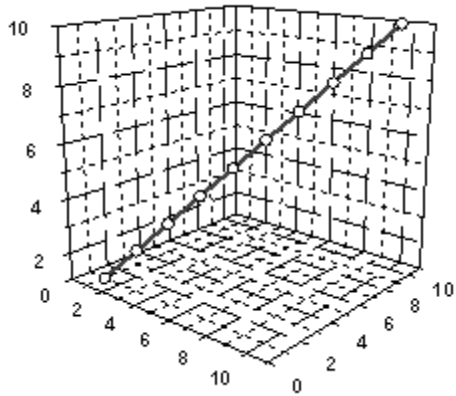
Note: To learn more about 3D scatter graphs, review the 3D SCATTER.OPJ project located in your Origin \SAMPLES\GRAPHING\3D PLOTS folder.

Template

3D.OTP (installed to the Origin program folder).

 [See your Origin software to view a multimedia demonstration on this topic \(*Help:Multimedia Demonstrations*\).](#)

Trajectory Graph



Data Requirements

Select one Z column (or a range from one Z column). If the Z column has an associated X column, then the X column is used; otherwise, the worksheet's default X values are used.

Creating the Graph

1. Select required data.
2. From the menu, choose **Plot:3D XYZ:3D Trajectory**.

or

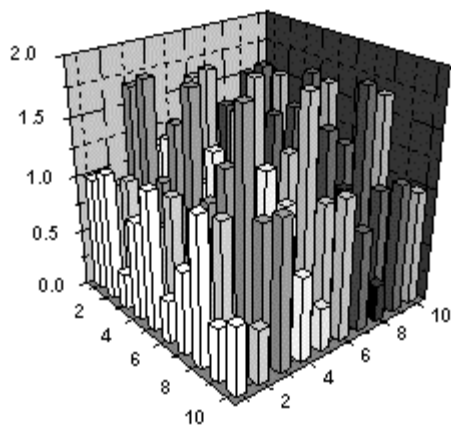
2. Click the **3D Trajectory**  button on the 3D Graphs toolbar.

Template

TRAJECT.OTP (installed to the Origin program folder).

3D Surfaces

Bars



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:3D Bars**.

or

2. Click the **Matrix 3D Bars**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(*Help:Multimedia Demonstrations*\).](#)

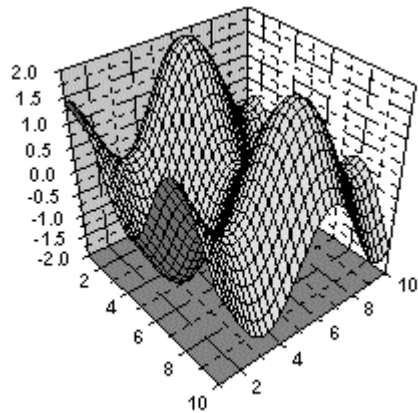
Template

3DBARS.OTP (installed to the Origin program folder).

Notes

The Z values represent the height of the columns (bars). The associated X and Y values mapped in the matrix determine the XY locations of each column.

Color Fill Surface



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix window to activate it.
2. From the menu, choose **Plot:3D Color Fill Surface**.

or

2. Click the **3D Color Fill Surface**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

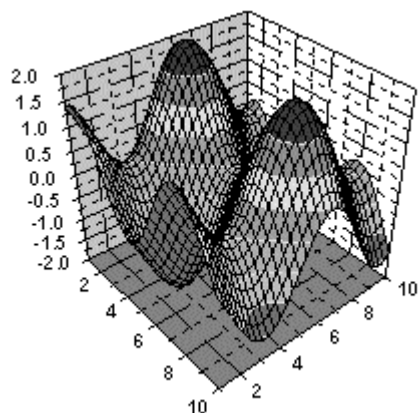
Template

MESH.OTP (installed to the Origin program folder).

Notes

The Z values determine a surface of X and Y grid lines with fill colors on the front and the back of the surface.

Color Map Surface



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:3D Color Map Surface**

or

2. Click the **3D Color Map**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Template

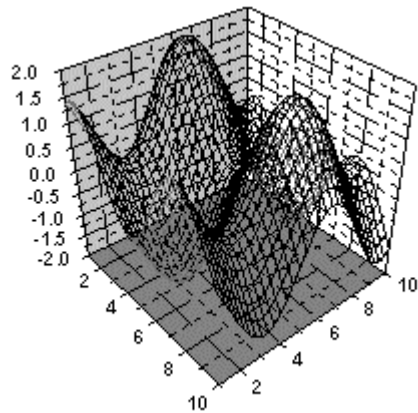
CMA.P.OTP (installed to the Origin program folder).

Notes

The Z values determine a surface of X and Y grid lines with fill colors on the front and the back of the surface. The front of the surface is filled using a color map with associated Z levels.

To learn more about 3D color map surface graphs, review the 3D SURFACE & CONTOUR.OPJ project located in your Origin \SAMPLES\GRAPHING\3D PLOTS folder.

Wire Frame



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:3D Wire Frame**.

or

2. click the **3D Wire Frame**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

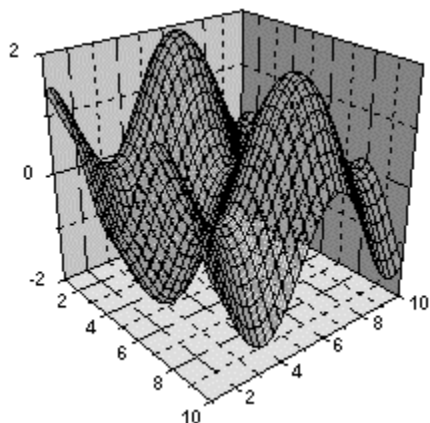
Template

WIREFRM.OTP (installed to the Origin program folder).

Notes

The Z values determine a surface of X and Y grid lines.

Wire Surface



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:3D Wire Surface**.

or

2. Click the **3D Wire Surface**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

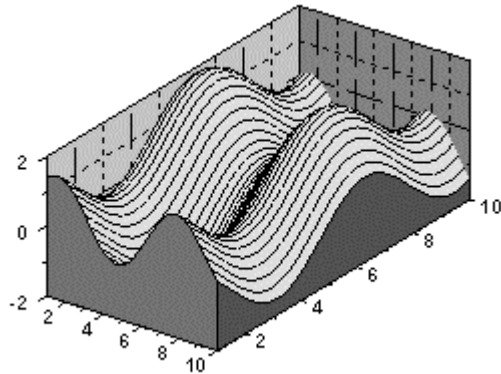
Template

WIREFACE.OTP (installed to the Origin program folder).

Notes

The Z values determine a surface of X and Y grid lines with secondary lines between the grids.

X Constant with Base Surface



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to make it active.
2. From the menu, choose **Plot:3D X Constant with Base**.

or

2. Click the **3D X Constant with Base**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

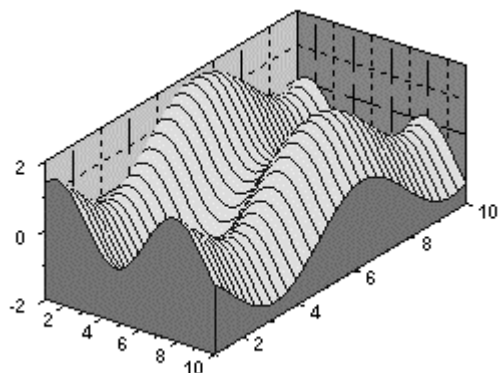
Template

XCONST.OTP (installed to the Origin program folder).

Notes

The Z values determine a surface of grid lines parallel to the Y axis. The front surface displays a fill color. X and Y side walls are also enabled.

Y Constant with Base Surface




Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:3D Y Constant with Base**.

or

2. Click the **3D Y Constant with Base**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Template

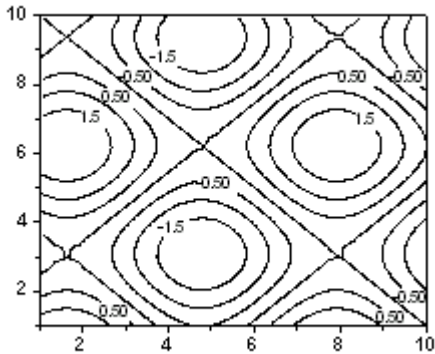
YCONST.OTP (installed to the Origin program folder).

Notes

The Z values determine a surface of grid lines parallel to the X axis. The front surface displays a fill color. X and Y side walls are also enabled.

Contour Graphs

Black and White Lines with Labels Contour



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:Contour - B/W Lines+Labels**.

or

2. Click the **Contour B/W Lines**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

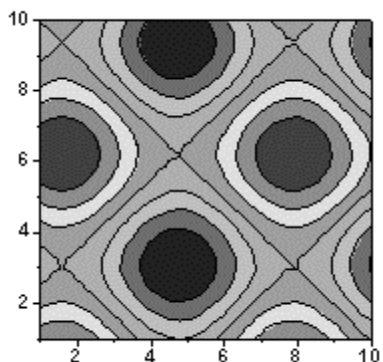
Template

CONTLINE.OTP (installed to the Origin program folder).

Notes

Ranges of Z values are denoted on an XY grid using contour lines and associated labels.

Color Fill Contour




Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:Contour - Color Fill**.

or

2. Click the **Contour - Color Fill**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Template

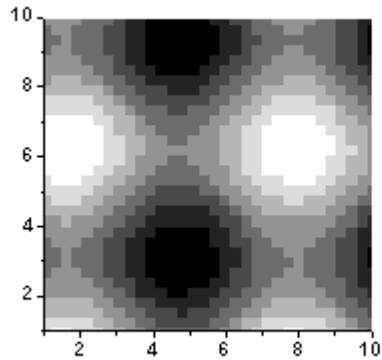
CONTOUR.OTP (installed to the Origin program folder).

Notes

Ranges of Z values are denoted on an XY grid using contour lines and fill colors from a color map.

To learn more about color map contour graphs, review the CONTOUR.OPJ project located in your Origin \SAMPLES\GRAPHING\3D PLOTS folder.

Gray Scale Map Contour



Data Requirements


A matrix of Z values.

Creating the Graph

1. Click on the matrix to activate it.
2. From the menu, choose **Plot:Gray Scale Map**.

or

2. Click the **Gray Scale Map**  button on the 3D Graphs toolbar.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Template

CONTGRAY.OTP (installed to the Origin program folder).

Notes

Ranges of Z values are denoted on an XY grid using a gray scale map.

The Graph: Layers


Defining the Layer

The layer is one of the fundamental building blocks of the Origin graph. Typically, the layer consists of one set of controlling axes, axis labels and one or more plotted data sets. The layer may also contain other objects -- for instance, data labels, text and drawing objects, etc. -- that pertain to the data that are plotted in the layer.

Each graph window is comprised of a single graph page and that page can contain up to 50 layers. The layers on a graph page can physically overlap or they can be spatially separated. Additionally, layers can be linked spatially or mathematically such that changes in location, size or axis scale of parent layers will affect the location, size, and axis scale of child layers. Because each graph layer is a distinct entity, you have great freedom to customize and combine layers in creative ways. Understanding the layer concept is key to creating unique, powerful, and highly effective graphs.

Typical Reasons for Adding Another Layer to a Graph:

- You wish to display the same data plot on different axis scales (Celsius vs. Fahrenheit, miles vs. kilometers).
- You want to create multiple separate data plots and include them on the same graph page.
- You want to create an "inset graph" that focuses on a specific region of a data plot and displays on a smaller separate set of axes within the frame of the entire data plot.

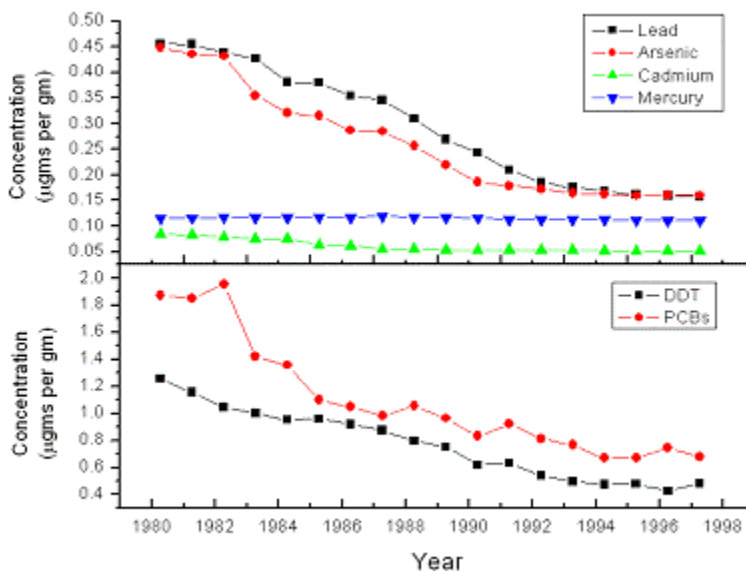
 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Examples of Multi-Layer Graphs

This line and symbol graph has two layers. Layers are stacked vertically. Each layer contains multiple data plots; the top layer contains four data sets and the bottom layer contains two.

Note that the two layers share a common X axis -- that is, the X axes for top and bottom layers are linked in a straight, one-to-one fashion. The graphs author has opted not to display the X axis scale values for the top layer.

Step-by-step instructions for creating this graph can be found at SAMPLES\GRAPHING\2D PLOTS\LINE AND SCATTER PLOTS.OPJ in the Origin program folder.



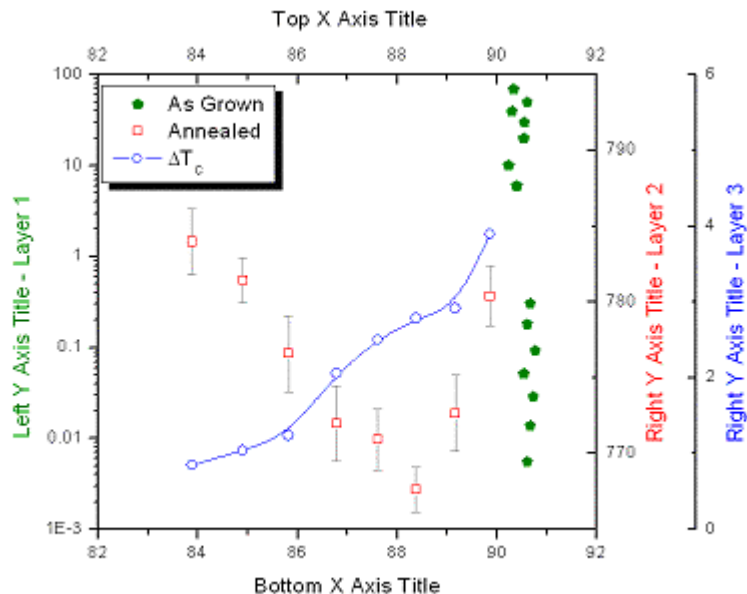
In this 2D scatter graph, three layers are superimposed. The graph's author uses color in the axis titles to help the viewer associate the each data plot with its respective axis title and axis scale.

Note, too, that the author has chosen to offset the rightmost Y axis -- the layer 3 axis -- from the layer 2 axis in order to display two different scales on the right side of the graph.

Other things to note:

- the logarithmic scale on the left Y axis.
- all three layers share a common X scale; X scales in layers 1, 2, and 3 are linked in a one-to-one fashion.

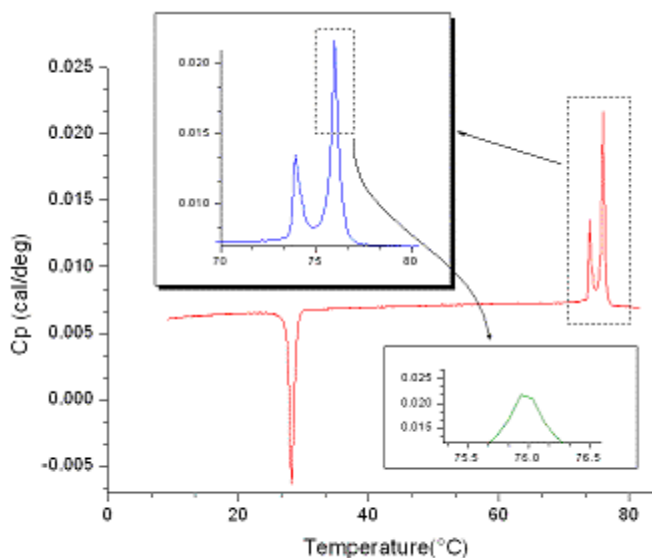
Step-by-step instructions for creating this graph can be found at SAMPLES\GRAPHING\2D PLOTS\LINE AND SCATTER PLOTS.OPJ in the Origin program folder.



In this 3 layer, 2D line graph, the author takes advantage of graph layer flexibility to create a primary graph and two inset graphs. The author focuses on a region of the main, red data plot to create an inset (the blue line plot) and then zooms in further to focus on a sub-region of the blue line plot (the green line plot).

Judicious use of drawing objects -- in this case arrows and curved arrows -- helps to clarify what the author has done.

Step-by-step instructions for creating this graph can be found at SAMPLES\GRAPHING\2D PLOTS\INSET.OPJ in the Origin program folder.

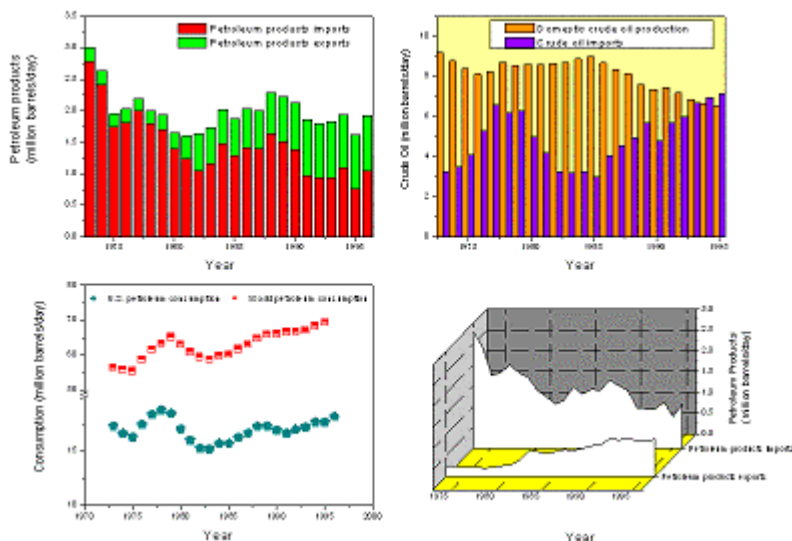


In this example, the author has merged four separate graphs of various types (a stacked and an unstacked bar graph, a 2D scatter and 3D Wall graph) to create a four layer, four panel graph in a single Origin graph window.

Merging and arranging Origin graphs in this way is a simple process using Origin's merge graphs feature and the Layer tool.



Step-by-step instructions for creating each of these graphs can be found at `SAMPLES\GRAPHING\EXCEL DATA\EXCEL DATA.OPJ` in the Origin program folder.

For more information on merging and arranging graphs using the Layer Tool, see page 252.

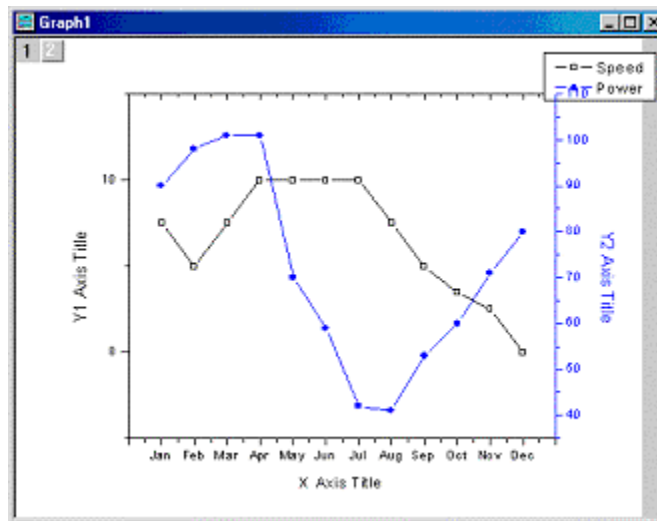


Creating a Simple Multi-Layer Graph

One common two-layer graph type calls for two dependent variables to be plotted against a single independent variable. In this short exercise, we will plot Wind Speed and Power against a common X axis variable -- Months of the Year. To complete the exercise:

1. Run Origin.
2. Click the **Import ASCII**  button on the Standard toolbar.
3. **Look in the Tutorial** subfolder of the Origin program folder.
4. Select WIND.DAT and click **Open**. This opens a single worksheet named **WIND**.
5. Highlight the **Speed(Y)** and **Power(Y)** columns.
6. Click the **Double Y Axis**  button on the 2D Graphs Extended toolbar.


Origin uses the built-in graph template called DoubleY to create a graph that looks something like this:



Things to note:

- The two small gray **1** **2** icons in the upper left corner of the graph window represent the two layers in this graph. The layer **1** icon is depressed indicating that this is the active layer.
- The Speed data -- represented by the open square line and symbol plot -- are plotted against the left Y axis.
- The Power data -- represented by the filled square line and symbol plot -- are plotted against the right Y axis.
- The left-most worksheet column -- Month -- supplies the X values for both Speed and Power data sets (thus, Speed and Power share a common X axis).
- The two graph layers are necessary because the two Y data sets -- Speed and Power -- are measured in differing units (thus, require different axis scales).

Be sure to read the section, on *Linking Layers* on page 245.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Adding Layers to the Graph

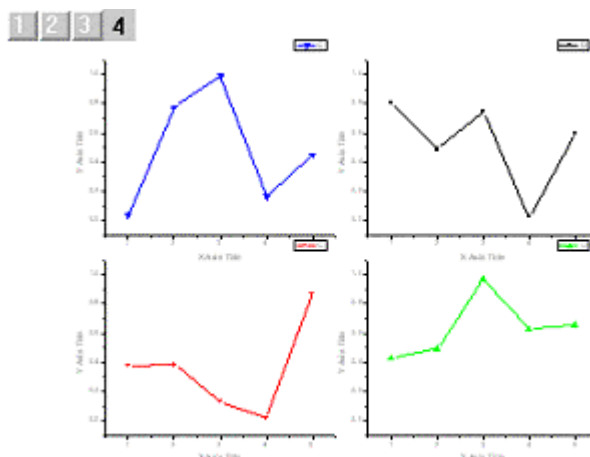
Using the Add & Arrange Layers Menu Command

To arrange layers on the page using the Add & Arrange Layers menu command (**Edit:Add and Arrange Layers**):

1. Select **Edit:Add & Arrange Layers**.

This menu command opens the **Total Number of Layers** dialog box. This dialog assumes that you want to arrange your layers in a **Rows** by **Columns** array (e.g. if you want to arrange four layers on the graph page

in a two layer by two layer fashion as in this figure, you would specify Number of Rows = 2 and Number of Columns = 2).



2. Enter **Number of Rows** and **Number of Columns** and click **OK**. This opens the **Spacings in % of Page Dimension** dialog box.
3. Specify layer spacings as a percentage of page dimensions and click **OK**. If you are unsure of the desired spacing, leave the settings at the default values. Note that you re-select the **Add & Arrange Layers** menu command if the spacing is n't to your liking.

The **Add & Arrange Layers** menu command requires that you specify a “complete” layer arrangement (i.e. 1, 2, 4, 9, 16, etc.). Therefore, if you specify a three by four arrangement and only have 11 layers, Origin will request permission to create an additional layer. If you decline, Origin arranges the existing layers, leaving blank spaces to round out the required number of layers.

All layers are necessarily the same size after the arrangement process. If you require layers of *non-uniform* size or spacing, resize layers graphically or use the controls on the **Size/Speed** tab of the layer's Plot Details dialog box.

Note: If you have any child layers that are spatially linked to a parent layer (% of Linked Layer is selected from the Units drop-down list on the Size/Speed tab of the child layer's Plot Details dialog box), then Origin maintains the parent/child relationship during layer arrangement. For example, if your graph window contains five layers and layer 2 is a linked right Y axis of layer 1, then when you select **Edit: Add & Arrange Layers** and specify a two column by two row arrangement, Origin will arrange the layers such that layer 2 maintains its right Y position with layer 1.

Using the New Layer (Axes) Menu Command

This method is useful for adding a new set of graph axes with a scale which is linked to the first layer.

Each of these menu commands creates a new layer that is linked to the active layer (the layer that was active when the menu command was selected, as indicated by the depressed layer icon). The new layer becomes a *child* layer of the parent (active) layer. The new child layer becomes the active layer once the operation is completed.







- **Edit: New Layer(Axes):(Linked): Top X + Right Y**
- **Edit: New Layer(Axes):(Linked): Top X**
- **Edit: New Layer(Axes):(Linked): Right Y**

For the **Edit:New Layer(Axes):(Linked):Top X** and **Edit:New Layer(Axes):(Linked):Right Y** menu commands, the axis that is not mentioned in the menu command is not displayed. It will, however, have its scale linked one-to-one with the corresponding axis in the parent layer.

Additionally, new linked layers can be added to the graph window using the Layer tool.


Adding Layers with the Layer Tool

To open the tool:

1. From the menu, select **Tools:Layer**.
2. Click on the **Add** tab to access the “new layer” buttons.
 - Click the **Normal X and Y** button  to add a layer with independent axes to the active graph window.
 - Click the **Linked Top X** button  to add a linked layer displaying a top X axis. The new layer is linked to the layer that was active when the button was clicked.
 - Click the **Linked Right Y** button  to add a linked layer displaying a right Y axis. The new layer is linked to the layer that was active when the button was clicked.
 - Click the **Linked Top X and Right Y** button  to add a linked layer displaying a top X and right Y axis. The new layer is linked to the layer that was active when the button was clicked.
 - Click the **Linked Inset** button  to add a linked inset layer displaying a bottom X and left Y axis. The new layer displays as an inset in the layer that was active when the Linked Inset button was clicked. The inset layer is created with a link to this layer.
 - Click the **Linked Inset with Data** button  to add a linked inset layer displaying a bottom X and left Y axis. This button functions the same as the Linked Inset button, however the inset layer displays all the data plots that are included in the parent layer.

Converting a Single Layer Graph into Multiple Layers

To convert a single layer graph window containing multiple data plots into a multiple layer graph window:

1. Activate the graph window and click the **Extract to Layers** button  on the Graph toolbar (**View:Toolbars**). This opens the **Total Number of Layers** dialog box. This dialog box assumes that you wish to arrange layers in a **Rows** by **Columns** array in the graph window.
2. Specify the **Number of Rows** and **Columns** and click **OK**. This opens the **Spacings in % of Page Dimension** dialog box.
3. Specify the page spacings (you can accept the defaults) and click **OK**. If you are not satisfied with the layer spacings, you can adjust layer spacings graphically or arrange them using the Layer Tool.

Adding Layers by Merging Pages

To merge separate graph pages into one graph window:

1. Activate the graph layer that you want to designate the parent layer in the new graph window. Note that this may not be important to you.
2. Select **Edit:Merge All Graph Windows**.

Any links that existed between layers before merging are preserved by the **Merge All Graph Windows** menu command. If a graph window contains two layers, and layer 2 is linked to layer 1, after the merge process this layer linking arrangement will still exist (although the layer numbers may change).

The Merge All Graph Windows command also preserves:

- Your **Custom** axis link settings.
- Spatial linking established by the specifying **% of Linked Layer** (from the **Units** drop-down list on the **Size/Speed** tab of the Plot Details dialog box).



Note: Spatial linking can sometimes produce unwanted layer arrangements in the merged graph window. We recommend removing any spatial links between layers before using the merge feature. To remove the link, open the **Size/Speed** tab of the Plot Details dialog box and select **% of Page** from the **Units** drop-down list.

Adding an Inset Graph

An inset graph is a layer which is added to an existing layer in a graph window. The dimensions of the inset layer are reduced so that the "host" layer remains at least partially visible in the graph window.

Though inset layers can be created manually by adjusting the position and size of two (or more) existing layers, Origin provides two buttons on the Layer tool to automatically create an inset graph.

Open the Layer tool by selecting **Tools:Layer**. Click on the **Add** tab.

1. Click the **Linked Inset** button  to add a linked inset layer displaying a bottom X and left Y axis. The new layer displays as an inset in the layer that was active when the Linked Inset button was clicked. The inset layer is created with a link to this layer. Thus, the inset layer is the child layer of its "host" layer (or parent layer).
2. Click the **Linked Inset with Data** button  to add a linked inset layer displaying a bottom X and left Y axis. This button functions the same as the Linked Inset button, however the inset layer displays all the data plots that are included in the "host" (or parent) layer.

Note: To learn more about inset graphs, review the INSET.OPJ project located in your Origin \SAMPLES\GRAPHING\2D PLOTS folder.

Using LabTalk to Add a Layer

You can add a layer to the active graph window by typing the following LabTalk command into the Script Window:

```
layer -n (ENTER)
```

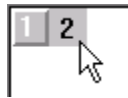
The layer is created with the default layer size and placement. The layer is not linked to a parent layer.

Linking Layers

Linking Layers to Control the Child Layer Position and Size

To create a link between two layers:

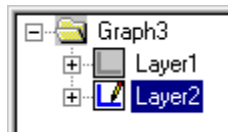
1. Click on the graph layer icon of the layer that you wish to establish as the child layer.



2. From the menu, select **Format:Layer**. This opens the layer's **Plot Details** dialog box.
3. Select the **Link Axes Scales** tab.
4. Select **Layer *n*** from the **Link To** drop-down list.
5. Click the **Apply** button.

Once you've linked the child layer to the parent layer, you can force the child layer to follow the size and position of the parent layer. To do this:

6. Select the **Size/Speed** tab (the child layer icon should still be selected on the left side of the Plot Details dialog box).



7. From the **Units** drop-down list, select **% of Linked Layer**.
8. Click **OK** to close the dialog box.


When the link is configured in this way, changes to the parent layer's size or position will force equivalent changes in the size or position of the child layer. The spatial relationship between parent and child layers is maintained. Note that the parent layer *must be the active layer*, when resizing or repositioning; if a child layer is the active layer, resizing or repositioning will break the established spatial relationship.

Note: The parent layer must have a lower layer number than the child layer. If necessary, use this LabTalk command to swap layer numbers:

page.reorder(Layer1, Layer2) <ENTER>

where **Layer1** and **Layer2** are layer numbers of the active graph window that you wish to exchange. To learn more about issuing LabTalk commands at the command prompt, see The **LabTalk Language Reference** section of the Programming Help file (**Help:Programming**).

A Layer Linking Example

1. Click the **New Graph**  button on the Standard toolbar.
2. Select **Edit:Add & Arrange Layers**.
3. In the Number of Rows text box, type **2** and click **OK**.
4. Click **Yes** at the Attention prompt (confirm the need to create one more layer).
5. Click **OK** to accept the default values in the **Spacings in % of Page Dimension** dialog box. You now have a two-layer graph, with the two layers stacked vertically.
6. Press CTRL while double-clicking on the layer 2 icon in the upper-left corner of the graph window. This opens the Plot Details dialog box. The layer 2 icon is highlighted in the left-hand pane.
7. Select the **Link Axes Scales** tab.
8. From the **Link To** drop-down list, select **Layer 1**.
9. Click the **Apply** button.

10. Select the **Size/Speed** tab.
11. From the **Units** drop-down list, select **% of Linked Layer**.
12. Click **OK** to close the dialog box.
13. Now click on the X axis in layer 1 (the *bottom* layer) to expose the layer's control handles.
Drag a control handle to resize the layer. Note that when you release the mouse button, layer 2 is automatically resized.
14. Move the pointer back to layer 1. When it becomes a 4-headed arrow, drag to move layer 1 to a new position on the graph page. Note that layer 2 moves with layer 1.

Linking Axes Scales

In addition to linking layers so that the child layer resizes and moves with the parent layer, you can also link layers so that the parent layer axis scale controls a child layer's axis scale values. To do this:

1. Click on the child layer's icon (or the layer that you want to be the child layer) in the upper-left corner of the graph window (note that the parent layer must always have a lower layer number than the child layer).
2. Select **Format:Layer**. This opens the child layer's Plot Details dialog box.
3. Select the **Link Axes Scales** tab. If you have not linked this layer to a parent layer, select the parent layer from the **Link To** drop-down list.

To establish an axis scale link:

- Select **None** to remove an existing link between the axes scales.
- Select **Straight (1 to 1)** to create a link in which the child layer axes mirror the scale values of the parent layer.
- Select **Custom** to create a mathematical relationship between the axes' scales. Specify this relationship using the X1= and X2= (or Y1= and Y2=) text boxes. These variables establish the **From** and **To** values for the axes of the child layer. Type the desired mathematical relationship in these text boxes to set the initial and final scale values for the child layer *in terms of* the parent layer scale values. For example:

To set X axis scale values in the child layer to exactly twice the X axis scale values of the parent layer, enter:

$$X1 = X1*2$$

$$X2 = X2*2$$

Note 1: You only have to link the X or the Y axis in a layer, without reference to the left versus right or top versus bottom axis. This is because the axes within a single layer necessarily share the same scale as they are effectively the same axis.

Note 2: The axis linking relationship is limited to the currently selected axis scale type (the **Type** drop-down list on the **Scale** tab of the **Axis** dialog box).



Note 3: If you add a layer to your graph by selecting either **Edit:New Layer(Axes):(Linked):Right Y** or **Edit:New Layer(Axes):(Linked):Top X**, an asterisk (*) displays in the X1 and X2 text boxes (linked right Y) or in the Y1 and Y2 text boxes (linked top X). This indicates that the link is a **Straight (1 to 1)** relationship.

Example: Creating a Custom Link Between Temperature Scales

The custom link option on the **Link Axes Scales** tab of the child layer's Plot Details dialog box is particularly useful if you want to display the same data plot on two scales, such as Celsius and Fahrenheit.

1. Create the following worksheet.

A[X]	B[Y]
25	1.1
35	1.6
45	2.4
55	2.8
65	3.4
75	4.1

2. Highlight the B(Y) column and click the **Scatter** button  on the 2D Graphs toolbar.
3. Double-click on the X axis title (graph window) to enter the text editing mode and overtype X Axis Title with **Centigrade**.
4. Click **OK** to close the dialog box.
5. Select **Tools:Layer** to open the Layer tool.
6. Click the **Add** tab and select the **Linked Top X** button  to add a linked layer (Layer 2) displaying a top X axis.
7. Double-click on the top X axis to open the **X Axis - Layer 2** dialog box. Select the **Title & Format** tab. Type **Fahrenheit** in the **Title** text box.
8. Click **OK** to close the dialog box.
9. Press CTRL while double-clicking on the graph window's layer 2 icon (in the upper left corner of your graph window). This action opens the Plot Details dialog box for layer 2.
10. Select the **Link Axes Scales** tab. In the **X Axis Link** group, select the **Custom** radio button and type the following expressions in the text boxes:

$$X1 = (X1 * 1.8) + 32$$

$$X2 = (X2 * 1.8) + 32$$

Origin recognizes **X1** and **X2** as LabTalk system variables for the **From** and **To** axis scale values, respectively. So these expressions say, in effect...

"Take the **From** axis scale value of layer 1, multiply it by 1.8, add 32 and use the resulting value for the **From** axis value of layer 2; take the **To** axis scale of layer 1, multiply it by 1.8, add 32 and use the resulting value for the **To** axis value of layer 2."

11. Click **OK** to close the Plot Details dialog box.

Arranging and Resizing Layers

Using the Axis Grid

You can enable a non-printing grid in the graph window to help you in graphically resizing or repositioning the layer. To enable the grid:

1. Make sure that the graph window is active.

- From the menu, choose **View:Show:Axis Grid**.

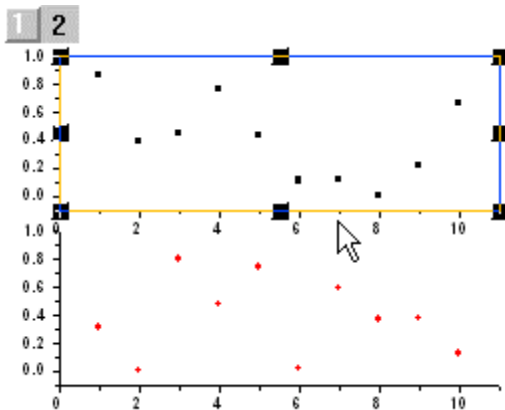
A check mark next to the menu item indicates that the grid is enabled. To turn off the grid, reselect (to uncheck) the **Axis Grid** menu item.

Other Grid Options

- To ensure that the layer axes are perfectly aligned with the grid, choose **Format:Snap Axes to Grid**, before moving the layer.
- To control axis grid spacing, choose **Tools:Options**. Select the **Page** tab and specify (type or select) **Grid Spacing for Axis**.

Graphically Resizing Layers on the Page

Activate the layer frame for sizing by clicking on one of the axes in the layer. When the frame is active, a sizing box with control handles displays:

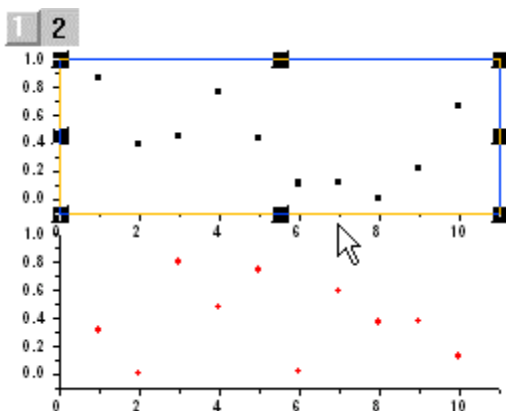


- To graphically resize the layer frame, drag a control handle. While dragging the control handle, an outline shows the size of the layer frame. The layer frame is resized when you release the left mouse button.
- To maintain the current aspect ratio of the layer while resizing, press and hold the CTRL key as you manipulate the control handle.

Use the axis grid to help you graphically resize or reposition the graph layer.

Graphically Positioning Layers on the Page

- Activate the layer frame for sizing by clicking on one of the axes in the layer. Once the frame is active, a sizing box with control handles displays:



2. Point anywhere inside the layer frame. When the pointer becomes a four-headed arrow, drag the layer to its new position.

Use the axis grid to help you graphically resize or reposition the graph layer.

Controlling Layer Size and Position via the Plot Details Dialog Box

Layer dimensions and position are controllable via the **Size/Speed** tab of the layer's Plot Details dialog box. This method is potentially more time-consuming than graphically resizing and repositioning the layer, but offers the advantage of more precise control.

To open **Size/Speed** tab of the Plot Details dialog box:

1. Activate the graph window.
2. Choose **Format:Layer**. The Plot Details dialog box opens. Note that the active layer icon will be highlighted in the left-hand pane of Plot Details.
3. Select the Size/Speed tab. **Layer Area** settings pertain to the active layer:
 - **Left** determines the position of the frame relative to the left side of the page.
 - **Top** determines the position of the frame relative to the top of the page.
 - The **Height** and **Width** values determine the size of the frame.

Use these settings in conjunction with [the Units list](#), to control layer size and position.

When **Units = % of Page**, layer size is controlled by page size.

Inch, cm, mm, pixel and **point** allow the user to specify exact layer position, independent of page size.

The **% of Linked Layer** option is *only* available if the active layer is linked to a parent layer.

This option is especially useful for applying changes that you have made to the size or position of a parent layer, to linked child layers. To learn more, see *Linking Layers to Control the Child Layer Position and Size* on page 245.

Note that when the unit selection changes, the **Left**, **Top**, **Height**, and **Width** values are converted automatically.

Note: Unless you have specifically chosen to offset axes, setting the size of the layer also sets the size of the *axes in the layer*. To specify axis width and height, select **Units** (for example, **inch**, **cm**, or **mm**), then enter the your dimensions in the **Width** and **Height** text boxes.

Controlling Layer Size and Position Using the Layer Tool

The **Arrange** tab of the Layer tool is especially useful for these layer positioning and resizing functions:

- Arranging (and adding) layers on the page.
- Specifying the page margins and spacings between graphs on a multi-panel graph page.

To open the **Layer** tool:

1. Activate the graph window.
2. Choose **Tools:Layer** from the menu.

The Arrange tab controls

- Layer Arrangement Group

Select the **Vertical Panel** radio button and click the **Arrange** button to arrange layers vertically, using settings in the **Margins** group.

Select the **Horizontal Panel** radio button and click the **Arrange** button to arrange layers horizontally, using settings in the **Margins** group.

Use the **N x M Panel** radio button *in conjunction with* the **Columns** by **Rows** text boxes to specify the layer arrangement, using the settings in the **Margins** group.

- ⇒ If **Add New Layers** is *selected*, additional layers are created, as needed, to construct the **Columns** by **Rows** layer array.
- ⇒ If **Add New Layers** is *cleared*, additional layers are not created, though spaces are created on the graph page if the specified **Columns** by **Rows** array is greater than the number of layers in the graph window.

- Margins Group

Use **Vertical Gap** and **Horizontal Gap** specify spacings between layers.

Use **Top**, **Left**, **Bottom** and **Right** to control the distance between the nearest graph layer and the edge of the graph page.

Note: Layers added by operations performed via the **Arrange** tab are not automatically linked to a parent layer.

Exchanging Layer Positions with the Layer Tool

Use the **Move** tab on the Layer Tool to swap the positions of two layers in your graph window:

1. Activate the graph window and select **Tools:Layer**.
2. In the **Move Layers** group, specify **Layer A** and **Layer B** and click the **Swap Layers A and B** button. Note that the layers keep their original layer numbers; only positions are swapped.

If one or both of layers **A** and **B** is a child layer which is dimensionally linked to a parent layer (**% of Linked Layer** is selected from the Units drop-down list on the Size/Speed tab of the Plot Details dialog box), Origin will update the **Layer Area** group information (**Left**, **Top**, **Width**, and **Height**) on the **Size/Speed** tab of the linked layer's Plot Details dialog box to reflect the layer's new position.

If one or both of layers **A** and **B** is a parent layer which is dimensionally linked to a one or more child layers, swapping a parent layer's position with another layer (either parent or child layer) will cause the **Units** of linked child layers to revert to the **% of Page** setting (Units drop-down list on the Size/Speed tab of the child layer's Plot Details dialog box). Subsequent resizing or repositioning of the parent layer will *not* produce a

commensurate resizing or repositioning of child layers unless **% of Linked Layer** has been re-selected for the child layers.

Overlaying Layers with the Layer Tool

To precisely overlay one graph layer with another:

1. Open the **Layer** tool (**Tools:Layer**).
2. Select the **Move** tab.
3. Choose (or type) the number of the layer to be moved in the **Layer A** text box.
4. Choose (or type) the number of the receiving layer in the **Layer B** text box
5. Click the **Move Layer A to B** button.

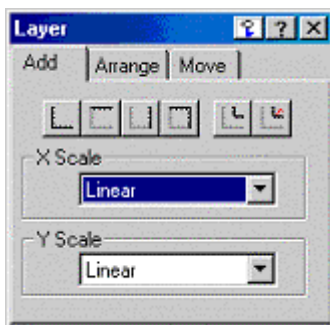
Layer A moves to Layer B. Origin resizes layer A, as necessary, so that layer dimensions are equal to those of layer B. Layer A is *not* automatically linked to Layer B.





Note: As the layers are drawn in order according to layer number, it is possible that overlaying one layer with another *may* obscure elements of the underlaying layer. If this occurs, select **Format:Page** from the menu, select the **Miscellaneous** tab, and verify that **Draw All Layers as a Single Composite** is selected (**Drawing Order** group). This setting will not affect coincident data points.



Reference: The Layer Tool

Dialog Box Controls

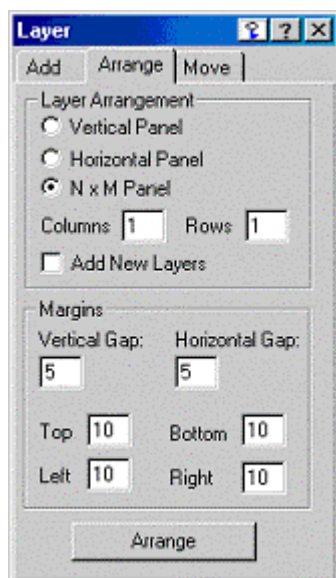
The Add tab



- Click the **Normal X and Y** button  to add a layer with independent axes to the active graph window.
- Click the **Linked Top X** button  to add a linked layer displaying a top X axis. The new layer is linked to the layer that was active when the button was clicked.
- Click the **Linked Right Y** button  to add a linked layer displaying a right Y axis. The new layer is linked to the layer that was active when the button was clicked.
- Click the **Linked Top X and Right Y** button  to add a linked layer displaying a top X and right Y axis. The new layer is linked to the layer that was active when the button was clicked.

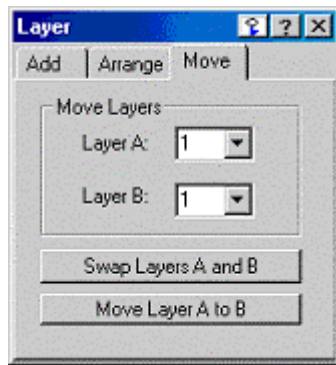
- Click the **Linked Inset** button  to add a linked inset layer displaying a bottom X and left Y axis. The new layer displays as an inset in the layer that was active when the Linked Inset button was clicked. The inset layer is created with a link to this layer.
- Click the **Linked Inset with Data** button  to add a linked inset layer displaying a bottom X and left Y axis. This button functions the same as the Linked Inset button, however the inset layer displays all the data plots that are included in the parent layer.
- Choose the X Scale type for the added layer.
- Choose the Y scale type for the added layer.

The Arrange tab



- Select **Vertical Panel** to stack layers vertically using the **Margins** dimensions.
- Select **Horizontal Panel** to arrange layers horizontally using the **Margins** dimensions.
- Select **N x M Panel** to arrange layers in a **Columns** by **Rows** array using the **Margins** dimensions.
- Select **Add New Layers** to create additional layers required to fill out the **N x M Panel**.
- Use **Margins** group settings to specify page margins and gaps in percentage of page size.
- Click the **Arrange** button to arrange layers in the active graph page according to specifications on the **Arrange** tab.

The **Move** tab

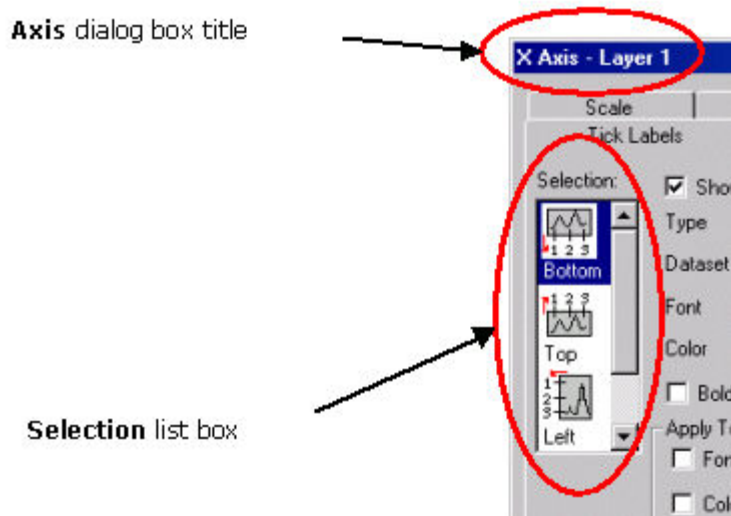


- Use the **Layer A** and **Layer B** drop-down lists to specify two layers to be combined or swapped.
- Use the 2 buttons on the bottom of the **Move** tab to **Move** or **Swap Layer A** and **Layer B**.

The Graph: Axes

General Tips on Editing Graph Axes

- Most graph axis properties are controlled by settings in the **Axis** dialog box. The **Axis** dialog box is a tabbed dialog that operates on the *currently selected axis*. The currently selected axis is identified by combined information in the **Axis** dialog box title and the **Selection** list box to the left side of the **Axis** dialog box.



In this example, the selected axis is the **Bottom X Axis** of **Layer 1**.

You can move freely from editing axis properties for any axis in a given layer to any other axis in the layer *without* closing the Axis dialog box. To edit the properties of other axes in the active graph layer, simply select the appropriate axis icon from the **Selection** list box.

Selections in this list box are limited to those that are relevant to the active graph template (for instance, you will not see a Z axis listed for a 2D plot-type) and to the properties that are relevant to controls on a particular dialog box tab, for example...

Typical 2D graph **Scale** tab selections are **Horizontal** or **Vertical** but the **Title & Format** tab settings for the same graph are **Top**, **Bottom**, **Left**, and **Right**. This is because a single 2D layer can have only one X (or one Y) scale, but could certainly display both Top X and Bottom X (or Left Y and Right Y) axes using the same scale. Settings on the **Scale** tab affect the axis scales. Settings on the **Title & Format** tab affect display of the top, bottom, left, and right axes.

- When you want to customize a particular Origin graph element, you usually gain access to element controls by double-clicking on that element. In the case of graph axes, double-clicking on the tick labels, axis grid lines, or an axis break, will open the **Axis** dialog box. There are other ways in which you can open the Axis dialog box:
 - Double-click on an tick label, axis grid line or axis break.

or

 - Right-click on an axis, tick mark, tick label, or axis break.
 - Select **Scale**, **Tick Labels**, or **Properties** from the shortcut menu.

or

1. Right-click in (or near) the layer containing the axis you want to edit.
2. Select **Axis** from the shortcut menu. (This shortcut menu command always opens the Axis dialog box with the X axis controls active.)

or

2. Select **Format:Axes:Axis Type** or **Format:Axis Tick Labels:Axis Tick Label Type**.

- When editing axis properties, you can prevent application of changes by clicking the **Cancel** button (provided you have not clicked **Apply**).

Axis Scale and Tick Mark Formatting

Changing the Axis Scale Type

Origin supports the following axis scale types for 2D graphs:

Linear	Standard linear scale: $X'=X$.
Log10*	Base 10 logarithmic scale: $X'=\log(X)$.
Probability	Represents the inverse of a cumulative Gaussian distribution. Plotting a cumulative Gaussian distribution produces a sigmoidally-shaped curve. This curve, when displayed on a probability scale, appears as a straight line. Since probabilities are expressed as percentages, all values must fall between 0 and 100. The probability scale range is 0.0001 to 99.999.
Probit	Like the probability scale, a sigmoidally-shaped curve plots as a straight line. In this case, however, the scale is linear, and the increment between tick marks is exactly one standard deviation. The value "5" on the scale shows the mean, or 50% probability. "6" is one standard deviation away, etc.
Reciprocal	Reciprocal scale, where $X'=1/X$.
Offset Reciprocal	Offset reciprocal scale, where $X'=1/(X+offset)$. <i>Offset</i> is defined as 273.14, where 273.14 is the absolute temperature for 0° C.
Logit	$\text{Logit}=\ln(Y/(100-Y))$. As with the probability and probit scales, a sigmoidally shaped curve plots as a straight line.
ln	Natural log scale (base e logarithmic scale).
log2	Base 2 logarithmic scale.

* A note about log10 scales:

Starting with Origin 7, if the log scale range is within one decade, the ticks and grids will be linear. A LabTalk system variable **@TL** determines whether to use linear tick marks by the following relation:

$$10 * \log_{10}(\text{max}/\text{min}) \leq \text{value}$$

Thus, to support linear tick locations for two decades, set this variable to 14.

For example, you could enter the following in the Script window:

```
@TL = 14 ;
```


The default value for **@TL** is 10.

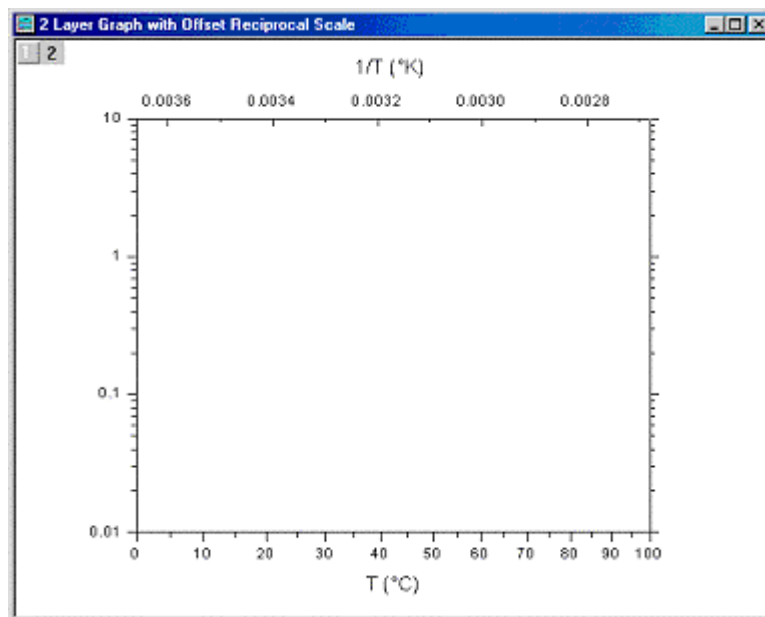
To change the axis scale type:

1. Double-click on the X, Y, or Z axis tick labels to open the **Axis** dialog box.
2. Select the **Scale** tab.
3. Select **Horizontal**, **Vertical**, or **Z Axes** from the **Selection** list box.
4. Select the axis scale from the **Type** drop-down list.
5. Click **OK** to close the dialog box and effect changes in the graph window.

To create a graph with an offset reciprocal scale:

The offset reciprocal scale type is defined as $x' = 1/(x+273.14)$, where 273.14 is the absolute temperature corresponding to zero degrees Celsius.

1. Click the **New Graph**  button on the Standard toolbar.
2. Double-click on the **X** axis.
3. Select the **Scale** tab (if it is not already active).
4. Type **0** in the **From** text box and **100** in the **To** text box.
5. Select **Offset Reciprocal** from the **Type** drop-down list.
6. Type **10** in the **Increment** text box.
7. Click **OK** to close the dialog box.
8. Select **Edit:New Layer (Axes):(Linked): Top X**.
9. Press CTRL while double-clicking on the layer **2** icon located in the upper-left corner of the graph. This action opens the layer's Plot Details dialog box.
10. Select the **Link Axes Scales** tab.
11. Select the **Custom** radio button in the **X Axis Link** group.
12. In this same group, type **1/(X1+273.14)** in the **X1** text box.
13. Type **1/(X2+273.14)** in the **X2** text box.
14. Click **OK** to close the dialog box.




Creating a Time Series Graph

Origin provides a powerful time series tick labeling feature that lets you automatically create axis tick labels with major tick units of seconds, minutes, hours, days, weeks, months, quarters, or years. You can display any date value between 1/1/0100 and 12/31/9999. Major and minor tick marks can be labeled separately. For example, you could label the major ticks as years and the minor ticks as months.

This short tutorial illustrates the development of a time series graph.

Setting the Axis Tick Label as Date

1. Click the **New Graph** button  on the Standard toolbar.
2. Double-click on the X axis tick labels to open the **Tick Labels** tab of the **Axis** dialog box.
3. Select **Date** from the **Type** drop-down list. The Date tick label type specifies that calendar values are to be used as labels.
4. To establish the tick label format, select **Jan 2** from the **Format** drop-down list.

Setting the Label Options

1. Select the **Minor Tick Labels** tab.
2. Select the **Enable Minor Labels** check box in the **Minor Labels** group. Minor tick marks on this axis will now be labeled.
3. Select the **Minor Label on Major Ticks** check box in the **Minor Labels** group. Minor tick labels will now display at major tick marks.
4. Type **110** in the **Offset Major by (%)** text box in the **Minor Labels** group. This will offset the major tick labels 110% of font height away from the axis.

Setting the Axis Range and Increment

1. Select the **Scale** tab.
2. Type **1/1/99** in the **From** text box, and **2/15/99** in the **To** text box.
3. Select the **Increment** radio button if it is not already selected.

4. Type **1week** in the Increment text box (do not leave a space between “1” and “week”). This establishes a major tick increment of one week. (Note: You can specify the following increment values when working with a time series axis (shown with appropriate abbreviations): **sec (s)**, **min (m)**, **hour (h)**, **day (d)**, **week (w)**, **month (mo)**, **quarter (q)**, **year (y)**.)
5. To specify a minor tick increment of one day, type **6** in the # **Minor Ticks** text box. Origin will draw six minor tick marks *between each pair of major ticks*. Origin automatically selects appropriate minor tick values, based on the increment setting. Since the major tick increment in the current example is one week, Origin will use the days of the week as minor tick values. In other circumstances, Origin might choose to use months or quarters as the minor tick increment.
6. Click **OK** to close the dialog box.

Other Axis and Tick Mark Options

Use settings on the Title & Format tab of the Axis dialog box control the following:

- Set axis and tick mark **Color**.
 1. Double-click on the axis tick labels to open the **Axis** dialog box.
 2. Select the **Title & Format** tab.
 3. Select a color from the **Color** drop-down list.
 4. Click **Apply** or **OK**.

Select **Color** in the **Apply To** group to apply **Color** to **This Layer**, **This Window**, or **All Windows** (in project).
- Set axis and tick mark **Thickness(pts)**.
 1. Double-click on the axis tick labels to open the **Axis** dialog box.
 2. Select the **Title & Format** tab.
 3. Specify an axis and tick **Thickness(pts)**.
 4. Click **Apply** or **OK**.

Select **Thickness** in the **Apply To** group to apply **Thickness(pts)** to **This Layer**, **This Window**, or **All Windows** (in project).
- Set **Major Tick Length**.
 1. Double-click on the axis tick labels to open the **Axis** dialog box.
 2. Select the **Title & Format** tab.
 3. Specify a **Major Tick Length**.
 4. Click **Apply** or **OK**.

Select **Tick Length** in the **Apply To** group to apply **Major Tick Length** to **This Layer**, **This Window**, or **All Windows** (in project).
- Set **Major** and **Minor Ticks** as **In**, **Out**, **In & Out**, or **None**.
 1. Double-click on the axis tick labels to open the **Axis** dialog box.
 2. Select the **Title & Format** tab.
 3. Set **Major** and **Minor Ticks** as **In**, **Out**, **In & Out** or **None**.
 4. Click **Apply** or **OK**.

Select **Ticks** in the **Apply To** group to apply **Major** and **Minor Ticks** configurations to **This Layer**, **This Window**, or **All Windows** (in project).

Turning On and Off the Display of the Axes

Each 2D graph layer can display **Bottom X**, **Top X**, **Left Y**, and **Right Y** axes. In addition, Origin's 3D graph layers can display **Front Z** and **Back Z** axes. By default, most built-in 2D graph templates display only the Bottom X and Left Y axes; the Top X and Right Y axes are hidden. You can opt to display all, some, or none of the layer's axes (and their associated tick marks). For instance...

To display the Top X and Right Y axes and tick marks

1. Double-click on the X axis tick labels to open the **X Axis** dialog box.
2. Select the **Title & Format** tab.
3. Select **Top** from the **Selection** list box.
4. Select the **Show Axis & Ticks** check box.
5. Select **Right** from the **Selection** list box.
6. Select the **Show Axis & Ticks** check box.
7. Click **OK** to close the dialog box and effect changes in the graph window.

To hide any of the axes in your graph layer

1. Open the **Axis** dialog box.
2. Select the **Title & Format** tab.
3. Highlight the appropriate axis in the **Selection** list box.
4. Clear the **Show Axis & Ticks** check box.

To hide the axis tick labels:

5. Select the **Tick Labels** tab.
6. Highlight the appropriate axis in the **Selection** list box.
7. Clear the **Show Major Labels** check box.

Origin provides a shortcut menu command to control the display of axes.

To hide an axis and its tick labels:

1. Right-click on the axis or tick labels.
2. Select **Hide Axis** from the shortcut menu.

The axis and tick labels are hidden when this command is checked. Furthermore, the **Show Axis & Ticks** check box on the **Title & Format** tab and the **Show Major Labels** check box on the **Tick Labels** tab of the **Axis** dialog box are simultaneously cleared.

To display the hidden axis and tick labels:

1. Reselect the shortcut menu command (which can be difficult because the axis is hidden).

or

1. Open the **Axis** dialog box and select the appropriate check boxes on the **Title & Format** tab and the **Tick Labels** tab.

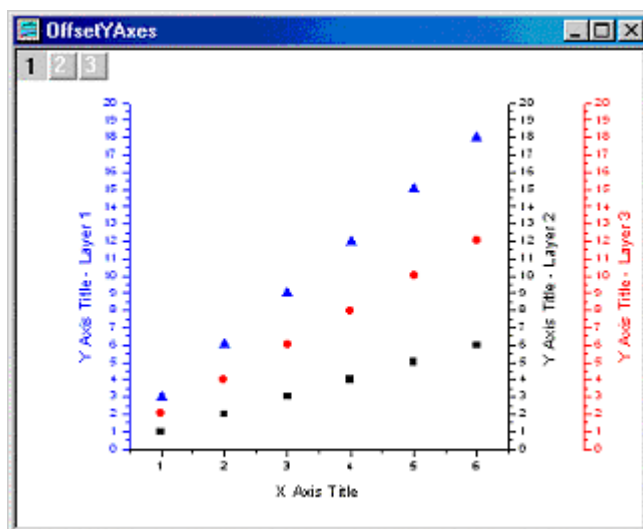
In addition to turning on and off the display of *individual axes*, Origin provides controls for display of *sets* of axes. For instance, to disable the display of the bottom X and top X axes (and tick labels) (even if they are currently hidden):

1. Activate the graph layer.
2. From the menu, choose **Format:Layer**. This opens the layer's **Plot Details** dialog box.
3. Select the **Display** tab.
4. Clear the **X Axes** check box in the **Show Elements** group (the **Labels** box controls display of axis titles, arrows, text labels, shapes, and objects -- *not* axis tick labels).

When X axes and tick labels are hidden at this level, you can still control their display *properties* from the **Axis** dialog box, but X axes and tick labels will not display until **X Axes** is restored to the **Display** tab.

Adjusting the Axis Position

By default, most 2D graph templates display a left Y and bottom X axis with the graph's origin being located in the lower left corner of the page. However, axes can be intersect at any value on the X or Y scale. Additionally, you could offset an axis from the layer frame so that, for instance, you could have multiple Right Y axes and not have the axes overlap (as in the following example).



To adjust the axis position:

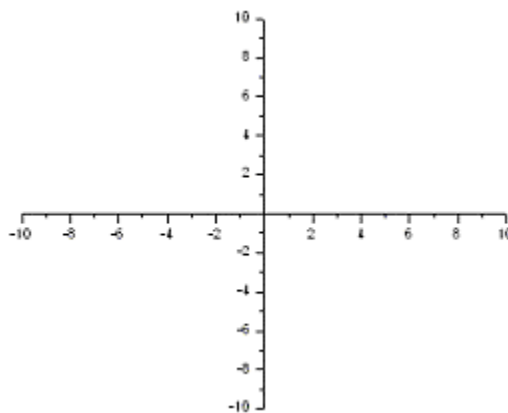
1. Double-click on the X, Y, or Z axis to open the **Axis** dialog box.
2. Select the **Title & Format** tab.
3. Select **Bottom**, **Top**, **Left**, **Right**, **Front**, or **Back** from the **Selection** list box.
4. Make your selection from the **Axis Position** drop-down list (continued on next page):


Bottom (X), Top (X), Left (Y), Right (Y), Front (Z), or Back (Z)	Move the axis back to its default location.
% from Bottom (Top, Left, Right, etc.)	Offset the axis from its default location. Type a “percent-of-axis-length” value in the Percent/Value text box. For axes in 2D graph layers, type a <i>positive</i> value to move the axis <i>away</i> from the center of the page; type a <i>negative</i> value to move the axis <i>toward</i> the center of the page.
At Position=	Position the axis at a specific X or Y axis scale value. Type the X or Y value in the Percent/Value text box.

- Click **OK** to close the dialog box and effect changes in the graph window.

Example

...to create this axis configuration:



- Click the **New Graph** button  on the Standard toolbar.
- Double-click on the X axis. This opens the **X Axis - Layer 1** dialog box.
- Select the **Title & Format** tab.
- Set **Axis Position** to **At Position=** and enter **0** in the **Percent/Value** text box.
- Click **Apply**. The X axis moves to position Y = 0.
- Select the **Scale** tab and change the **From** to **-10** and **To** to **10**.
- From the **Selection** list, choose **Left** (note that the dialog box name is changed to **Y Axis - Layer 1** -- we are now formatting the Y axis).
- Set **Axis Position** to **At Position=** and enter **0** in the **Percent/Value** text box.
- Select the **Scale** tab and change the **From** to **-10** and **To** to **10**.
- Click **Apply** or **OK**. The Y axis moves to position X = 0.

Adding a Grid

Grid lines can be displayed at major and minor ticks for the X, Y, and Z axes. When displayed, these lines will appear in the printed graph.

To add grid lines to the graph

1. Double-click on the X, Y, or Z axis to open the **Axis** dialog box.
2. Select the **Grid Lines** tab.
3. Select **Horizontal**, **Vertical**, or **Z Axes** from the **Selection** list box.
4. Select the **Major Grids** and/or the **Minor Grids** check boxes to display the respective grid.
5. Set the grid line display options.
6. Click **OK** to close the dialog box and effect changes in the graph window.

Note: The grid lines as controlled from the Axis dialog box are *not* the same as the axis and object grids used for alignment. Note that the alignment grids *do not* appear in the printed graph.

Displaying the Grid in Front of (or Behind) the Data

Grid lines can be displayed in front of, or behind, the data in your 2D graphs. To change the way that grid lines display:

1. Press CTRL while double-clicking on the appropriate layer icon in the upper-left corner of the graph window. This action opens the layer's Plot Details dialog box.
2. Select the **Display** tab.
3. To display the grid lines *in front of* the data, select the **Grid on Top of Data** check box (in the **Data Drawing Options** group).

or

3. Clear this check box to display the grid lines *behind* the data.

Adding, Deleting, and Formatting an Axis Break in a 2D Graph

An axis break is a gap inserted into an axis to indicate that a range of values is skipped (not displayed in the graph). A single axis break can be added to any X or Y axis in a 2D graph.

To add an axis break:

1. Double-click on the X (or Y) axis to open the **Axis** dialog box.
2. Select the **Break** tab.
3. Select **Horizontal** or **Vertical** from the **Selection** list box.
4. Select the **Show Break** check box.
5. Type the starting break value in the **From** text box.
6. Type the ending break value in the **To** text box.
7. Click **OK** to close the dialog box and effect changes in the graph window.

To edit or remove an axis break

1. Double-click on the axis break. This action opens the **Break** tab of the Axis dialog box.
 2. To *remove* the break, clear the **Show Break** check box.
- or*
2. To *modify* the break, edit the options on this tab and click **OK**.

To connect a (plotted) line across an axis break

1. From the menu, choose **Format:Page**. This opens the page's Plot Details dialog box.
2. Select the **Display** tab.
3. Select the **Connect Line Across Axis Break** check box.

In a line+symbol data plot, the line across the break region displays as a dashed line.

Axis Scale Values

Changing the Axis Scale and Increment

When you plot data from the worksheet or import data into a graph window, X, Y, and Z axes are automatically scaled so as to include all data points in the data plot. All built-in Origin graph templates determine minimum and maximum axis values by padding the range of X, Y, and Z data by 8%.

To alter the default display margin, change the value of the **layer.axis.rescaleMargin** object property.

For more information, see documentation of the **layer.axis** property in the **LabTalk Language Reference** section of the **Programming Help** file (**Help:Programming**).

To change the axis scale and customize the increment

1. Double-click on the X, Y, or Z axis to open the respective **Axis** dialog box.
2. Select the **Scale** tab.
3. Select **Horizontal**, **Vertical**, or **Z Axes** from the **Selection** list box.
4. Type your starting axis scale value in the **From** text box.
5. Type your ending axis scale value in the **To** text box.
6. To set the major tick increment, select the **Increment** radio button. Type the increment between major ticks in the associated text box.
7. To specify the number of major ticks displayed on the axis, select the **# Major Ticks** radio button. Type the number of major ticks in the associated text box.
8. Specify the number of minor ticks to display between adjacent major ticks in the **# Minor Ticks** text box.
9. Click **OK** to close the dialog box and effect changes in the graph window.

other methods of changing the axis scale:

- See, *Changing the Axis Scale using the Zoom In Button on the Tools Toolbar* on page 265.
- See, *Changing the Axis Scale using the Center Shortcut Menu Command* on page 265
- See, *Changing the Axis Scale Using the Axis Zoom In and Axis Zoom Out Shortcut Menu Commands* on page 266.

Locating Tick Marks


The location of tick marks is controlled by settings on the **Scale** tab of the Axis dialog box. The *format* of tick marks is controlled by settings on the **Title & Format** tab.

To control the location of tick marks

1. Double-click on the X, Y, or Z axis to open the **Axis** dialog box.
2. Select the **Scale** tab.
3. Select **Horizontal**, **Vertical**, or **Z Axes** from the **Selection** list box.
4. To set the major tick increment, select the **Increment** radio button and specify the increment between major ticks in the associated text box.
5. To specify the number of major ticks displayed, select the **# Major Ticks** radio button and specify the number of major ticks in the associated text box.
6. Specify the number of minor ticks between adjacent major ticks, in the **# Minor Ticks** text box.
7. Click **OK** to close the dialog box and effect changes in the graph window.


Note: Major tick length is set from the **Major Tick Length** combination box on the **Title & Format** tab. Units are 0.1 point.

Changing the Axis Scale using the Zoom In Button on the Tools Toolbar

To change the axis scale and enlarge a region of your data plot, use the **Zoom In** button  on the **Tools** toolbar:

1. Click once on the button to select it.
2. Drag out a rectangle around the region of the graph that you want to enlarge. When you release the mouse button, the axes rescale to display only the selected data.

To return the axis scale to the full range:

3. Double-click on the **Zoom In**  button.

or

3. Click on the **Zoom Out** button  on the **Tools** toolbar.

or

3. Click the **Rescale to Show All**  button on the Graph toolbar.

Note: Though the Zoom In button on the Tools toolbar is available (not grayed out) for 3D graphs, its use is not recommended. Use one of the other axis scale editing methods.

Changing the Axis Scale using the Center Shortcut Menu Command

To center your data plot on a particular X, Y or Z axis scale value:

1. Right-click on a tick label.
 2. Choose **Center** from the shortcut menu.
- This alters the **From** and **To** values in the **Axis** dialog box.

To return the axis scale to its full range:

1. Right-click on the axis tick labels.
2. Select **Rescale to Show All** from the shortcut menu

or

2. Click the **Rescale**  button on the **Graphs** toolbar.

Changing the Axis Scale Using the Axis Zoom In and Axis Zoom Out Shortcut Menu Commands


You can modify the **From** and **To** axis scale values using the **Axis Zoom In** and **Axis Zoom Out** shortcut menu commands. Decide which axis scale value you want to zoom in on, then:

1. Right-click on that axis tick label.
2. Choose **Axis Zoom In** from the shortcut menu.

Origin rescales the axis so that the X, Y, or Z location that you chose displays near the center of the graph axis. This narrows the range of the **From** and **To** values in the **Axis** dialog box. Note that this is similar to Changing the Axis Scale using the Center Shortcut Menu Command.

To return the axis scale to its full range:

Note that the shortcut menu item, **Axis Zoom Out** has the effect of expanding the scale. However, to show all data and return to the original scale values:


1. Right-click on the axis tick labels.
2. Select **Rescale to Show All** from the shortcut menu or click the **Rescale**  button on the **Graphs** toolbar.

Rescaling the Axes to Display Data that Extends Beyond the Current Axes Range

Origin provides an option to reset the axes scale values so that all the data included in the active layer displays within the layer frame. To reset the axes scale values:

1. From the menu, select **Graph:Rescale to Show All**

or

1. Click the **Rescale** button  on the Graph toolbar. This operation is most useful when data plots that extend beyond the current axes range are added to the layer, or when the worksheet display range is modified.

The operation has no effect on the “speed mode” setting which reduces the number of points in a data plot by plotting only every *n*th data point in the data set. The rescale operation resets axis scale values only.

Note: If you have selected Manual from the Rescale drop-down list on the Scale tab of the Axis dialog box, Origin asks you if you want to override the manual rescale setting. If you click No, the axes will not rescale to show all the data.

Controlling the Axis Rescale Mode

Origin provides an option to control the conditions under which the axis is rescaled.

To control the axis rescale mode:

1. Double-click on the X, Y, or Z axis to open the respective **Axis** dialog box.
2. Select the **Scale** tab.
3. Select **Horizontal**, **Vertical**, or **Z Axes** from the **Selection** list box.
4. Select the rescale mode from the **Rescale** drop-down list.

Manual	The axis is <i>not</i> scaleable. If you try to change the scale or perform an operation which changes the scale (for example, using the Enlarger tool), Origin preserves the From and To values. If both axes in a 2D graph layer are set to Manual , using the Enlarger tool opens a dialog box asking if you want to change to Normal mode and rescale. Click Yes to <i>temporarily</i> override the scaling restriction.
Normal	The axis <i>is</i> scaleable. Alter the axis scale and use the Enlarger tool (for 2D graph layers) without restriction.
Auto	This option is identical to the Normal option, but also allows Origin to automatically scale the axis to accommodate plotted data, if necessary.
Fixed From	The From value of the axis is fixed and can only be changed by editing the From text box value in the Axis dialog box.
Fixed To	The To value of the axis is fixed and can only be changed by editing the To text box value in the Axis dialog box.

5. Click **OK** to close the dialog box and effect changes in the graph window.

Axis Scale Tick Labels

Formatting Tick Labels

To customize the axis tick labels:

1. Double-click on the X, Y, or Z axis labels to open the respective **Axis** dialog box.
2. If not already selected, select the **Tick Labels** tab.
3. Use the **Selection** list box to choose **Bottom**, **Top**, **Left**, **Right**, **Front** or **Back** axes.

The **Tick Labels** tab settings control these tick label format options:

- Show or hide major tick labels.

Select this check box to display major tick labels (this control also appears on the **Minor Tick Labels** tab and the **Custom Tick Labels** tab).

Use the **Apply To** group to apply your settings to **This Layer**, **This Window**, or **All Windows** (this project).

- Specify the source for labels using the **Type** drop-down list.

The default selection in this drop-down list is the **Format** selection in the **Worksheet Column Format** dialog box. However, editing **Type** does *not* reset the Worksheet Column Format.

If you edit the **Type** drop-down list, you may have to adjust the axis scale and increment (the **Scale** tab). For instance, when choosing the **Day of Week** option

for X axis tick labels, select the Scale tab and set the scale **From 0 To 6**, and the **Increment** to 1.

Numeric	The tick labels are decimal numbers representing the axis scale range.
Text from Data set	Uses a data set as the source of the tick labels. You can select a data set from any worksheet in the project by typing or selecting the data set from the Data set combination box (for example, data1_c). For each major tick label, Origin checks what the tick label value of <i>numeric type</i> would be (using the settings on the Scale tab). It then uses that numeric value as a row number, and displays the cell value in the selected data set at that row number for the tick label.
Time	Displays tick labels in 24-hour clock format, with hour:minute:second:fraction-of-second separated by semicolons.
Date	Displays tick labels as calendar-accurate date values.
Month	Displays tick labels as month values. This option accepts numeric or text data set values.
Day of Week	Displays tick labels as days of the week.
Column Headings	<p>Uses (plotted) worksheet column headings as tick labels. Plot the desired data sets from the worksheet into the layer. Select the Column Headings option from this drop-down list.</p> <p>Origin creates tick labels from the headings of the <i>plotted</i> columns. The tick labels derived from column headings are positioned along the axis such that the numeric axis scale value equals the column number. For example, if the numeric axis tick label reads "5," Origin replaces that tick label with the heading from column 5. (When counting columns, Origin ignores any X column.</p> <p>Note: Column headings include both the column name and label. To display only the worksheet column label as a tick label, clear the Column Name check box (Heading Options group) and click OK. Make the graph active again and select Window:Refresh.</p>
Tick Indexed Dataset	<p>As with the Text from Dataset option, the Tick Indexed Dataset option uses a data set as the source of the tick labels. You can select a data set from any worksheet in the project by typing or selecting the data set from the Dataset combination box (for example, data1_c).</p> <p>This option differs from the Text from Dataset option in that each data set value is indexed to sequential major tick positions, starting with the first major tick on the axis. Thus, the value in row one of the specified data set displays at the first major tick, the value in row two displays at the second major tick, etc.</p>

Use the **Apply To** group to apply your settings to **This Layer**, **This Window**, or **All Windows** (this project).

- Specify **Font**, **Color**, **Bold** and/or **Point** (size).

Use the **Apply To** group to apply your settings to **This Layer**, **This Window**, or **All Windows** (this project).

- Specify a label **Display**.

Type = Numeric

Option	Description																																	
Decimal:1000	(1, 1000, 1E6, 1E9) Note: The threshold for conversion to scientific notation is controlled on the Numeric Format tab of the Options dialog box (Tools:Options).																																	
Scientific:1E3	(1E0, 1E3, 1E6, 1E9)																																	
Engineering:1k*	(1.0, 1.0k, 1.0M, 1.0G) <u>Origin supports the following Engineering data suffixes:</u> <table><tr><th>suffix</th><th>equivalent</th><th>quantity</th></tr><tr><td>k</td><td>kilo</td><td>10^3</td></tr><tr><td>M</td><td>mega</td><td>10^6</td></tr><tr><td>G</td><td>giga</td><td>10^9</td></tr><tr><td>T</td><td>tera</td><td>10^12</td></tr><tr><td>P</td><td>peta</td><td>10^15</td></tr><tr><td>m</td><td>milli</td><td>10^-3</td></tr><tr><td>u</td><td>micro</td><td>10^-6</td></tr><tr><td>n</td><td>nano</td><td>10^-9</td></tr><tr><td>p</td><td>pico</td><td>10^-12</td></tr><tr><td>f</td><td>femto</td><td>10^-15</td></tr></table> <p>Note that "u" is Origin's universal notation for micron. The only exception is graph axes tick labels, which support "mu". Note also that Origin 7 does not support "E" and "a" as suffixes.</p>	suffix	equivalent	quantity	k	kilo	10^3	M	mega	10^6	G	giga	10^9	T	tera	10^12	P	peta	10^15	m	milli	10^-3	u	micro	10^-6	n	nano	10^-9	p	pico	10^-12	f	femto	10^-15
suffix	equivalent	quantity																																
k	kilo	10^3																																
M	mega	10^6																																
G	giga	10^9																																
T	tera	10^12																																
P	peta	10^15																																
m	milli	10^-3																																
u	micro	10^-6																																
n	nano	10^-9																																
p	pico	10^-12																																
f	femto	10^-15																																
Decimal:1,000	(1, 1,000, 1E6, 1E9) Note: The threshold for conversion to scientific notation is controlled on the Numeric Format tab of the Options dialog box (Tools:Options).																																	

*A LabTalk system variable (@EF) is provided to enter engineering notation in a non-engineering column. If you set @EF = 1, and then enter engineering notation in a non-engineering column, Origin will treat the entry as numeric. Otherwise (@EF = 0), Origin will treat the entry as text (default). To learn more about LabTalk system variables, see the LabTalk Help file.

Type = Time

The Display drop-down list provides a display selection of hours (hh), minutes (mm), seconds (ss), fractions-of-second (#=tenths, ##=hundredths, ###=thousandths), and an AM/PM indicator (am/pm).

*Type = **Date***

The Display drop-down list provides a display selection of date values. The entire date value - month, day, and year - is always preserved, but specific sections of the date can be displayed.

The first two date formats from the drop-down list display your Windows regional date setting (the first item is the short regional format and the second is the long regional format). You can customize these Windows regional settings and thus access the custom format in Origin.

Origin's date formats are listed below these regional formats.

The last two date formats in the drop-down list are Origin's available custom date formats. To customize these date formats, edit the Custom Dates Formats group on the Miscellaneous tab of the Options dialog box (**Tools:Options**).

Also, see the **Worksheet Column Format** Dialog Box on page 50.

*Type = **Month***

Three month display formats are available: *J* abbreviates the month to a single letter, *Jan* abbreviates to three letters, and *January* displays the entire month.

*Type = **Day of Week***

Three day of week display formats are available: *M* abbreviates the day to a single letter, *Mon* abbreviates to three letters, and *Monday* displays the entire word.

- Optionally, specify a **Divide By Factor**, **Decimal Places**, **Prefix** and/or **Suffix**.

4. Click **Apply** or **OK**.

Turning On and Off the Display of Tick Labels

To turn on or off the display of tick labels

1. Double-click on the X axis to open the **X Axis** dialog box.
2. Select the **Tick Labels** tab.
3. Select **Top** from the **Selection** list box.
4. Select the **Show Major Labels** check box.
5. Select **Right** from the **Selection** list box.
6. Select the **Show Major Labels** check box.
7. Click **OK** to close the dialog box and effect changes in the graph window.

In addition to turning on and off the display of *individual axes and tick labels*, Origin provides controls for display of *sets* of axes and associated tick labels. For instance, to disable the display of the bottom X and top X axes and tick labels (even if they are not currently visible):

1. Activate the graph layer.
2. From the menu, choose **Format:Layer**. This opens the layer's **Plot Details** dialog box.
3. Select the **Display** tab.

4. Clear the **X Axes** check box in the **Show Elements** group (the **Labels** box controls display of axis titles, arrows, text labels, shapes, and objects -- *not* axis tick labels).

When X axes and tick labels are hidden at this level, you can still control their display *properties* from the **Axis** dialog box, but X axes and tick labels will not display until **X Axes** is restored to the **Display** tab.

The Custom Tick Labels Tab: Advanced Control over Tick Labels

Origin provides advanced control over tick labels. These options include tick label formatting, alignment, and control over individual tick labels. To access the advanced tick label control, select the Custom Tick Labels tab of the Axis dialog box. For more information on this tab, see The Custom Tick Labels Tab.

Axis Titles

Adding, Editing, and Positioning an Axis Title

Origin's graph window templates attach a default title to each axis. In most cases, the default axis titles are visible when the graph window is created.

Axis titles display just outside of their respective axes. The default distance between the axis tick labels and the axis title is controlled on the **Axis** tab of the **Options** dialog box (**Tools:Options**).

Though you can modify the location of an axis title by selecting and dragging the title, its movement is restricted to a small area in the vicinity of the axis tick labels. This is because the axis title is a *special* Origin text object. The formatting of this object (font size, position, attachment method, etc.) is modified by several "hard-coded" parameters associated with the axis title **Object Name** (e.g. **XB** is the object name of the bottom X axis in a 2D plot). Any time the graph is refreshed, these parameter specifications are read and this object is automatically formatted. If you wish to have complete control over the position, attachment method, etc. of your axis title, you must rename the object.

1. Right-click on the axis title and choose **Label Control**.
2. Edit the **Object Name** text box.

You now have complete control over the axis title but note that such things as *automatic positioning and scaling of the axis title have been disabled*.

To display an axis title for an axis which currently does not include a title

1. Select **Format:Axis Titles:X (or Y or Z) Axis Title** to open the **Text Control** dialog box for the associated axis.
2. Type the desired title text into the text box and format the text as desired.
3. Click **OK** to close the dialog box. The axis title displays near the center of the axis.

or

1. Select **Format:Axes:X Axis (or Y Axis or Z Axis)**.
2. Select the **Title & Format** tab.
3. Choose the appropriate axis in the **Selection** list box.
4. Select (if not checked) the **Show Axis & Ticks** check box.
5. Enter a **Title**.

6. Click **Apply** or **OK**.

To edit an existing axis title

1. Double-click on the axis title to activate in-place editing mode.
2. Edit the axis title as desired.
3. To exit the text editing mode, click off the label or press ESC.

Tip: To control rotation of vertical labels during in-place editing, select **Tools:Options**, select the **Text Fonts** tab, edit the **Do Not Rotate Text While In-Place Editing** check box.

For more information on naming and formatting of text and drawing objects, see *Editing Objects* on page 402.

Other Axis Customizations

Exchanging the X and Y Axes in a 2D Graph Layer

To exchange the X and Y axes so that the X axis becomes the vertical axis and the Y axis becomes the horizontal axis:

1. Activate the graph window.
2. Select **Graph:Exchange X-Y Axis**.

Changing the Length of the Axis

The length of a set of axes in a layer is determined by the dimensions of the layer that contains the axes. The layer size is set on the Size/Speed tab of the layer's Plot Details dialog box (**Format:Layer**).

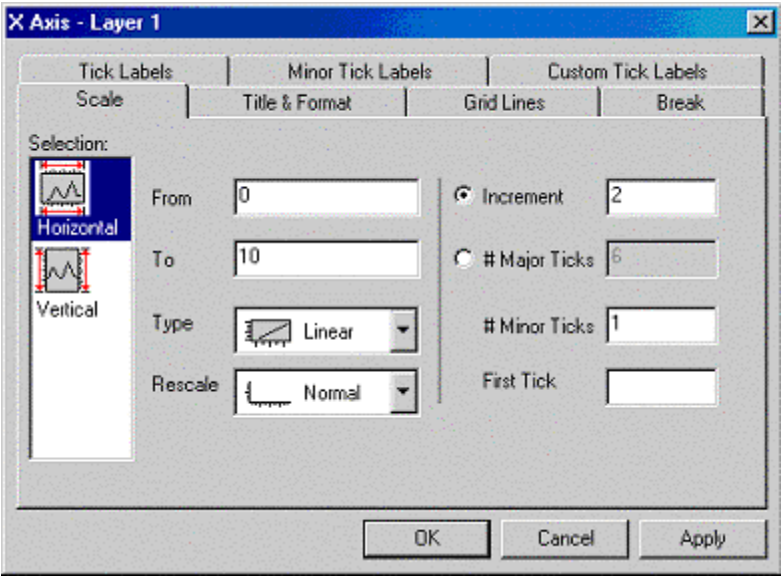
To set the layer (and thus the axes) to a specific width and height, select the desired units (for example, inch, cm, or mm) from the Units drop-down list in the Layer Area group. Then enter the desired dimensions in the Width and Height text boxes. (The Left and Top text boxes determine the position of the layer relative to the left side and top of the page.)

You can also set the layer size in relation to the size of the page, or in relation to a linked layer. For more information on these options, see *Plotting: Graph Layers* on page 239.

Reference Section: The Axis Dialog Box

The Scale Tab

Scale Tab Controls



The Selection List Box

Horizontal	This is, by default, the bottom and top X axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Horizontal icon is associated with the left and right Y axes.
Vertical	This is, by default, the left and right Y axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Vertical icon is associated with the bottom and top X axes.
Z Axes	This is, by default, the front and back Z axes.

After you finish editing the properties of an axis, you can begin editing any other axis in your graph by selecting the appropriate icon from the **Selection** list box. To prevent your selections from applying to your graph, click the **Cancel** button at any time during the editing process (but before clicking **Apply**).

The From Text Box

Set the initial scale value in this text box.

The To Text Box

Set the final scale value in this text box.

The Type Drop-down List

Linear	Standard linear scale: $X'=X$.
Log10*	Base 10 logarithmic scale: $X'=\log(X)$.
Probability	Represents the inverse of a cumulative Gaussian distribution. Plotting a cumulative Gaussian distribution produces a sigmoidally-shaped curve. This curve, when displayed on a probability scale, appears as a straight line. Since probabilities are expressed as percentages, all values must fall between 0 and 100. The probability scale range is 0.0001 to 99.999.
Probit	Like the probability scale, a sigmoidally-shaped curve plots as a straight line. In this case, however, the scale is linear, and the increment between tick marks is exactly one standard deviation. The value "5" on the scale shows the mean, or 50% probability. "6" is one standard deviation away, etc.
Reciprocal	Reciprocal scale, where $X'=1/X$.
Offset Reciprocal	Offset reciprocal scale, where $X'=1/(X+offset)$. <i>Offset</i> is defined as 273.14, where 273.14 is the absolute temperature for 0° C.
Logit	$\text{Logit}=\ln(Y/(100-Y))$. As with the probability and probit scales, a sigmoidally shaped curve plots as a straight line.
ln	Natural log scale (base e logarithmic scale).
log2	Base 2 logarithmic scale.

*A note about log10 scales:

Starting with Origin 7, if the log scale range is within one decade, the ticks and grids will be linear. A LabTalk system variable **@TL** determines whether to use linear tick marks by the following relation:

$$10 * \log_{10}(\text{max/min}) \leq \text{value}$$

Thus, to support linear tick locations for two decades, set this variable to 14. For example, you could enter the following in the Script window:

```
@TL = 14 ;
```

The default value for **@TL** is 10.

The Rescale Drop-down List

Manual	The axis is <i>not</i> scaleable. If you try to change the scale or perform an operation which changes the scale (for example, using the Enlarger tool), Origin preserves the From and To values. If both axes in a 2D graph layer are set to Manual, using the Enlarger tool opens a dialog box asking if you want to change to Normal mode and rescale. Click Yes to temporarily override the scaling restriction.
Normal	The axis <i>is</i> scaleable. Alter the axis scale and use the Enlarger tool (for 2D graph layers) without restriction.
Auto	This option is identical to the Normal option, but also allows Origin to automatically scale the axis to accommodate plotted data, if necessary.
Fixed From	The "From" value of the axis is fixed and can only be changed by editing the From text box value in the Axis dialog box.
Fixed To	The "To" value of the axis is fixed and can only be changed by editing the To text box value in the Axis dialog box.

The **Increment** Radio Button and Text Box

Select this radio button and set the major tick increment for this axis in the associated text box. Tick labels are placed at each major tick mark. For example, type **10** to display a major tick mark at every tenth value.

If the scale units for this axis are time series values, then the value in the Increment text box must indicate the increment in appropriate time series terms. The permissible time series step increment units and their allowable abbreviations are:

Increment	Abbreviation
sec	s
min	m
hour	h
day	d
week	w
month	mo
quarter	q
year	y

For time series graphs, set the size of the increment by typing a number followed by an increment unit. For example, **1month** sets a major tick increment of one month. **4Q** sets a major tick increment of four quarters. (Do not leave a space between the number and the increment unit.)

The # **Major Ticks** Radio Button and Text Box

Select this radio button to set the absolute number of major ticks displayed on the axis. Type the desired value in the associated text box.

The maximum number of major ticks is controlled on the Axis tab of the Options dialog box (**Tools:Options**).

The # **Minor Ticks** Text Box

Specify the number of minor ticks to display between adjacent major ticks in this text box. For example, select the Increment radio button, type **1** in the associated text box, and type **1** in the # Minor Ticks text box to set the tick sub-step to 0.5. One minor tick will display between each pair of major ticks.

If the scale units for this axis are time series values, then Origin uses the value in the # Minor Ticks text box to *automatically* determine the most appropriate minor tick labels. This option is available only if the Enable Minor Labels check box is selected on the Minor Tick Labels tab of the Axis dialog box.

The **First Tick** Text Box

Specify the position of the first major tick, and the increment for each minor tick, in the **First Tick** text box. *This text box can be left blank for most graphs.* However, when using calendar-accurate date values as tick labels, you may want to specify the value of the first major tick label to be displayed, and at what value subsequent minor ticks should fall. For example, if your X axis range runs from 1/1/99 to 12/31/99, you could specify that the first major tick label fall at 1/4/99, and that all subsequent minor tick marks fall on a Monday.

To edit the First Tick text box, type the desired major tick value. To specify both a major and minor tick value, include a comma after the major tick value, followed by the minor tick value.

When working with date values, Origin recognizes most common date notations. For example, to create an axis that starts at 1/4/99 and has minor tick marks at all Mondays, enter any of the following in the First Tick text box:

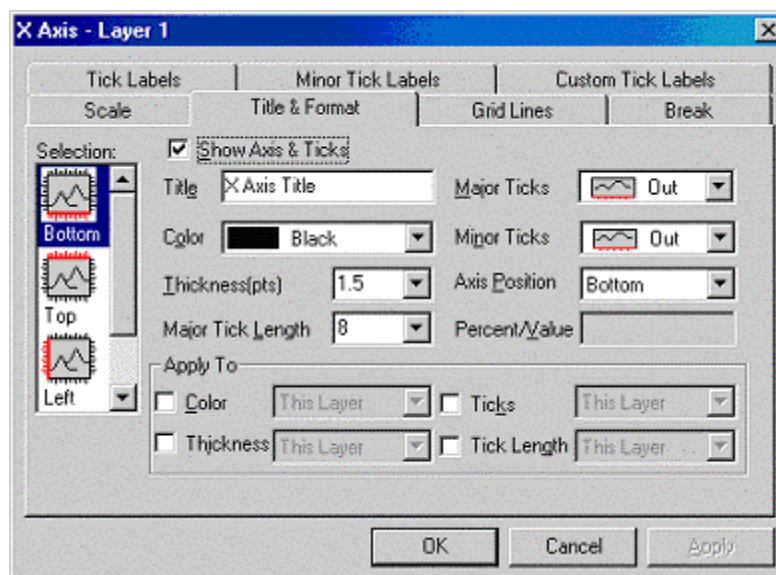
1/4/99, Monday

1-4-99, Mon

Jan 4 1999, M

The Title & Format Tab

Title & Format Tab Controls



The Selection List Box

Horizontal	This is, by default, the bottom and top X axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Horizontal icon is associated with the left and right Y axes.
Vertical	This is, by default, the left and right Y axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Vertical icon is associated with the bottom and top X axes.
Z Axes	This is, by default, the front and back Z axes.
Bottom	This is, by default, the bottom X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Top	This is, by default, the top X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Left	This is, by default, the left Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Right	This is, by default, the right Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Front	This is, by default, the front Z axis.

Back	This is, by default, the back Z axis
-------------	--------------------------------------

After you finish editing the properties of an axis, you can begin editing any other axis in your graph by selecting the appropriate icon from the **Selection** list box. To prevent your selections from applying to your graph, click the **Cancel** button at any time during the editing process (but before clicking **Apply**).

The Show Axis & Ticks Check Box

Select this check box to display the axis and ticks for the current axis **Selection**.

Conversely, to hide the axis and ticks, clear this box.

The Title Text Box

Type an axis title in this text box.

The Color Drop-down List

Select an axis and tick color from this drop-down list.

The Thickness (pts) Combination Box

Type or select the desired line thickness (in points, where 1 point=1/72 inch) for the axis and ticks from this combination box.

The Major Tick Length Combination Box

Type or select the desired major tick length (in points, where 1 point=1/72 inch) from this combination box.

The Major Ticks Drop-down List

Control the display of the major ticks from this drop-down list.

The Minor Ticks Drop-down List

Control the display of the minor ticks from this drop-down list.

The Axis Position Drop-down List and the Percent/Value Text Box

Bottom (X), Top (X), Left (Y), Right (Y), Front (Z), or Back (Z)	Move the axis back to its default location.
% from Bottom (Top, Left, Right, etc.)	Offset the axis from its default location. Type a “percent-of-axis-length” value in the Percent/Value text box. For axes in 2D graph layers, type a <i>positive</i> value to move the axis <i>away</i> from the center of the page; type a <i>negative</i> value to move the axis <i>toward</i> the center of the page.
At Position=	Position the axis at a specific X or Y axis scale value. Type the X or Y value in the Percent/Value text box.

The Apply To Group

Select the **Color** check box to apply the current selection from the **Color** drop-down list to: **This Layer**, **This Window**, or **All Windows** (in the current project).

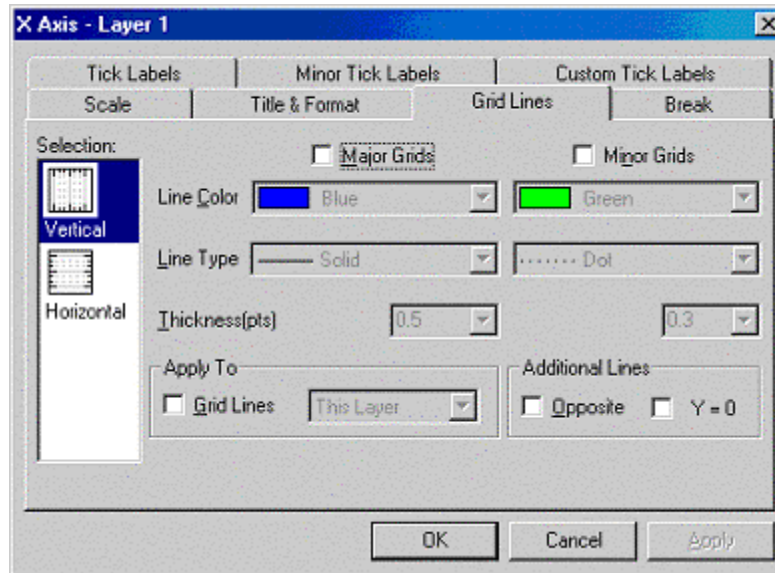
Select the **Thickness** check box to apply the current selection from the **Thickness (pts)** combination box to: **This Layer**, **This Window**, or **All Windows** (in the current project).

Select the **Ticks** check box to apply the current selection from the **Major Ticks** and the **Minor Ticks** drop-down lists to: **This Layer**, **This Window**, or **All Windows** (in the current project).

Select the **Tick Length** check box to apply the current selection from the **Major Tick Length** combination box to: **This Layer**, **This Window**, or **All Windows** (in the current project).

The Grid Lines Tab

Grid Lines Tab Controls



The Selection List Box

Horizontal	This is, by default, the bottom and top X axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Horizontal icon is associated with the left and right Y axes.
Vertical	This is, by default, the left and right Y axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Vertical icon is associated with the bottom and top X axes.
Z Axes	This is, by default, the front and back Z axes.

After you finish editing the properties of an axis, you can begin editing any other axis in your graph by selecting the appropriate icon from the **Selection** list box. To prevent your selections from applying to your graph, click the **Cancel** button at any time during the editing process (but before clicking **Apply**).

The Major Grids Group

Select the **Major Grids** check box to display major grids. Major grid lines are straight lines that emanate from major tick marks.

Select the desired line color and line type from the associated drop-down lists.

Type or select the desired line thickness (in points) from the **Thickness (pts)** combination box.

The Minor Grids Group

Select the **Minor Grids** check box to display minor grids. Minor grid lines are straight lines that emanate from minor tick marks.

Select the desired line color and line type from the associated drop-down lists.

Type or select the desired line thickness (in points) from the **Line Thickness (pts)** combination box.

The Apply To Group

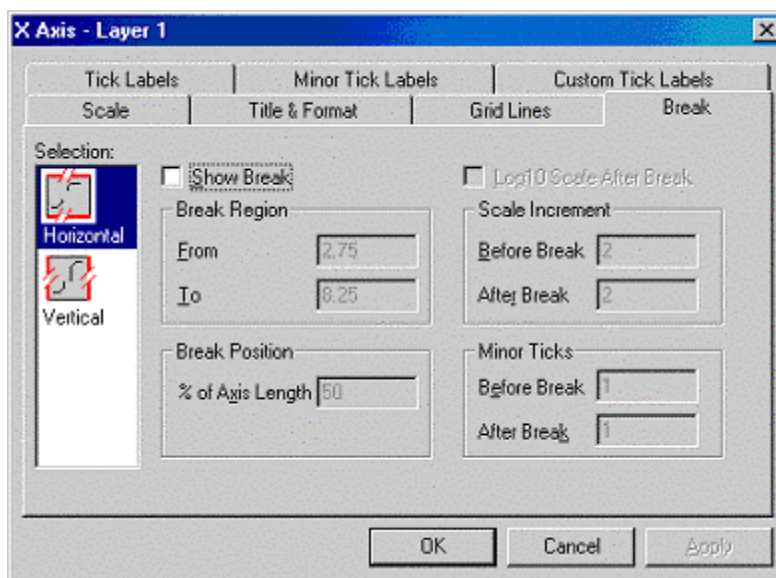
Select the **Grid Lines** check box to apply the current selection from the **Line Color** and the **Line Type** drop-down lists, and the **Thickness (pts)** combination box for both the **Major Grids** and the **Minor Grids** group to: **This Layer**, **This Window**, or **All Windows** (in the current project).

The Additional Lines Group

Select the **Opposite** check box to display a straight line opposite the current axis. Select the **Y=0** (**X=0**, or **Z=0**) check box to display a straight line at $Y=0$ ($X=0$, or $Z=0$).

The Break Tab

Break Tab Controls



The Selection List Box

Horizontal	This is, by default, the bottom and top X axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Horizontal icon is associated with the left and right Y axes.
Vertical	This is, by default, the left and right Y axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Vertical icon is associated with the bottom and top X axes.

After you finish editing the properties of an axis, you can begin editing any other axis in your graph by selecting the appropriate icon from the **Selection** list box. To prevent your selections from applying to your graph, click the **Cancel** button at any time during the editing process (but before clicking **Apply**).

Note: You cannot add an axis break to the axes in a 3D graph layer.

The Show Break Check Box

Select this check box to create an axis break.

The Break Region Group

The **From** text box value determines the last value displayed before the axis break. The **To** text box value determines the first value displayed after the axis break.

The Break Position Group

The **% of Axis Length** text box value determines the position of the break on the axis. This value is in units of % of axis length. For example, type **50** in this text box to position an axis break at the mid-point of the axis. If necessary, Origin will alter the scale on either side of the break to accommodate the specified position.

The Log10 Scale After Break Check Box

Select this check box to set the post-break scale to log10.

The Scale Increment Group

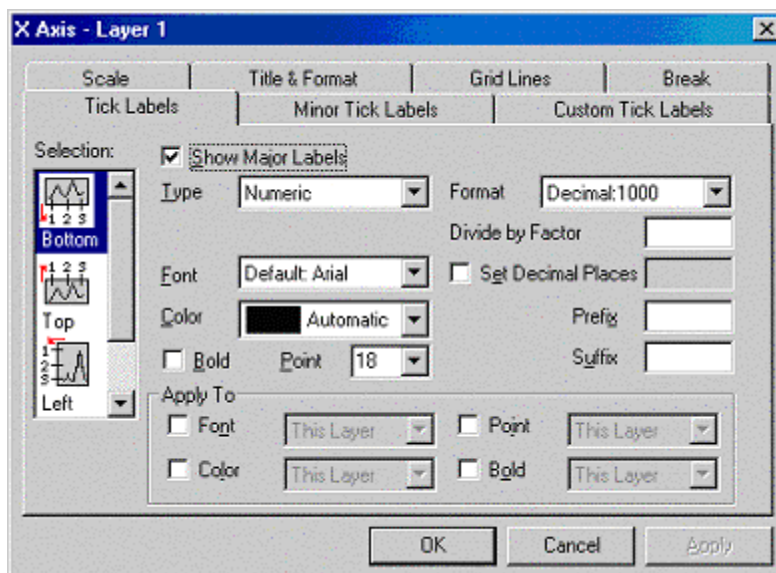
The **Before Break** and the **After Break** text box values determine the pre-break and post-break step increment. Origin draws a major tick mark and a tick label at each step increment interval.

The Minor Ticks Group

The **Before Break** and the **After Break** text box values determine the number of minor ticks (between major ticks) before and after the break. This setting overrides the **# Minor Ticks** text box value on the **Scale** tab.

The Tick Labels Tab

Tick Labels Tab Controls



The Selection List Box

Bottom	This is by default the bottom X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Top	This is by default the top X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Left	This is by default the left Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Right	This is by default the right Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Front	This is by default the front Z axis.
Back	This is by default the back Z axis.

Note that you can move from editing one axis to another without closing the **Axis** dialog box, by selecting another axis in the **Selection** list box. To discard changes, click the **Cancel** button (but before clicking **Apply**).

The Show Major Labels Check Box

Select this check box to display major tick labels. This display is also controlled on the **Minor Tick Labels** tab and the **Custom Tick Labels** tab.

The Type Drop-down List

Select the label type from this drop-down list. The default selection in this drop-down list is the **Format** selection in the **Worksheet Column Format** dialog box. However, editing **Type** does *not* reset the Worksheet Column Format.

If you edit the **Type** drop-down list, you may have to adjust the axis scale and increment (the **Scale** tab). For instance, when choosing the **Day of Week** option for X axis tick labels, select the **Scale** tab and set the scale **From 0 To 6**, and the **Increment** to 1.

Numeric	The tick labels are decimal numbers representing the axis scale range.
Text from Data set	Uses a data set as the source of the tick labels. You can select a data set from any worksheet in the project by typing or selecting the data set from the Data set combination box (for example, data1_c). For each major tick label, Origin checks what the tick label value of <i>numeric type</i> would be (using the settings on the Scale tab). It then uses that numeric value as a row number, and displays the cell value in the selected data set at that row number for the tick label.
Time	Displays tick labels in 24-hour clock format, with hour:minute:second:fraction-of-second separated by semicolons.
Date	Displays tick labels as calendar-accurate date values.
Month	Displays tick labels as month values. This option accepts numeric or text data set values.
Day of Week	Displays tick labels as days of the week.
Column Headings	<p>Uses (plotted) worksheet column headings as tick labels. Plot the desired data sets from the worksheet into the layer. Select the Column Headings option from this drop-down list.</p> <p>Origin creates tick labels from the headings of the <i>plotted</i> columns. The tick labels derived from column headings are positioned along the axis such that the numeric axis scale value equals the column number. For example, if the numeric axis tick label reads "5," Origin replaces that tick label with the heading from column 5. (When counting columns, Origin ignores any X column.)</p> <p>Note: Column headings include both the column name and label. To display only the worksheet column label as a tick label, clear the Column Name check box (Heading Options group) and click OK. Make the graph active again and select Window:Refresh.</p>
Tick Indexed Dataset	<p>As with the Text from Dataset option, the Tick Indexed Dataset option uses a data set as the source of the tick labels. You can select a data set from any worksheet in the project by typing or selecting the data set from the Dataset combination box (for example, data1_c).</p> <p>This option differs from the Text from Dataset option in that each data set value is indexed to sequential major tick positions, starting with the first major tick on the axis. Thus, the value in row one of the specified data set displays at the first major tick, the value in row two displays at the second major tick, etc.</p>

The Font Drop-down List

Select the major and minor tick label font from this drop-down list.

The Color Drop-down List

Select the desired major and minor tick label color from this drop-down list.

The Bold Check Box

Select the **Bold** check box to bold major and minor tick labels.

The Point Combination Box

Type or select the desired line thickness (in points) for the major and minor tick labels from the **Point** combination box.

The Display Drop-down List

The drop-down list options differ depending on the selection from the **Type** drop-down list.

The **Divide By Factor** Text Box

Each major and minor tick label is divided by the number in this text box. Note that this text box also supports expressions. For example, to divide all the labels by $1/3$, enter $1/3$ in the text box.

The **Set Decimal Places** Check Box and Text Box

To specify the number of decimal places displayed in the numeric tick labels, select this check box and type the desired value in the associated text box.

The **Prefix** Text Box

Type a prefix in this text box to display before the major and minor tick labels.

Note: The **Prefix** and **Suffix** text boxes support special formatting commands (for example, superscript and subscript). For information on using special formatting commands, see Plotting: Customizing the Graph.

The **Suffix** Text Box

Type a suffix in this text box to display after the tick labels. For example: mm, μF , K.

The **Prefix** and **Suffix** text boxes support special formatting commands (for example, superscript and subscript). For information on using special formatting commands, see Plotting: Customizing the Graph.

The **Apply To** Group

Select the **Font** check box to apply the current selection from the **Font** drop-down list to: **This Layer**, **This Window**, or **All Windows** (in the current project).

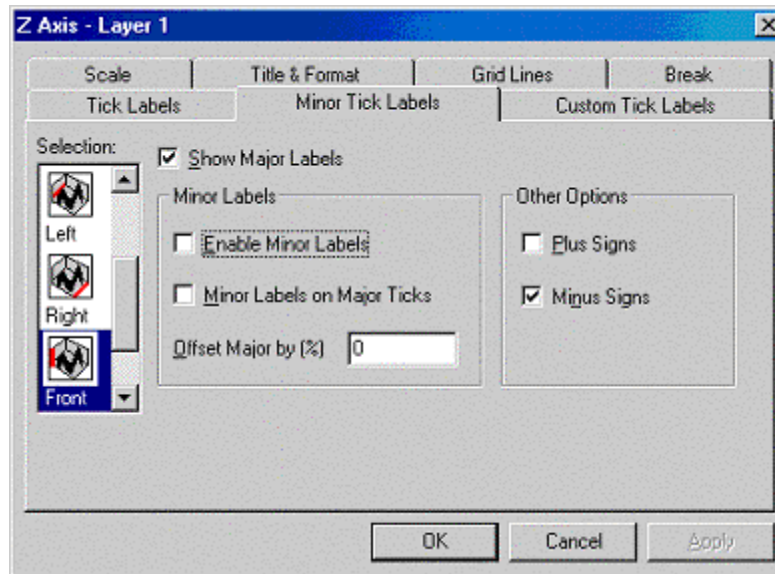
Select the **Color** check box to apply the current selection from the **Color** drop-down list to: **This Layer**, **This Window**, or **All Windows** (in the current project).

Select the **Point** check box to apply the current selection from the **Point** combination box to: **This Layer**, **This Window**, or **All Windows** (in the current project).

Select the **Bold** check box to apply the current selection from the **Bold** check box to: **This Layer**, **This Window**, or **All Windows** (in the current project).

The Minor Tick Labels Tab

Minor Tick Labels Controls



The Selection List Box

Horizontal	This is, by default, the bottom and top X axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Horizontal icon is associated with the left and right Y axes.
Vertical	This is, by default, the left and right Y axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Vertical icon is associated with the bottom and top X axes.
Z Axes	This is, by default, the front and back Z axes.
Bottom	This is, by default, the bottom X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Top	This is, by default, the top X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Left	This is, by default, the left Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Right	This is, by default, the right Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Front	This is, by default, the front Z axis.
Back	This is, by default, the back Z axis.

After you finish editing the properties of an axis, you can begin editing any other axis in your graph by selecting the appropriate icon from the **Selection** list box. To prevent your selections from applying to your graph, click the **Cancel** button at any time during the editing process (but before clicking **Apply**).

The Show Major Labels Check Box

To display minor tick labels, major tick labels must be displayed.

Select the **Show Major Labels** check box to display major tick labels. Other major tick label display controls are on the **Tick Labels** tab and on the **Custom Tick Labels** tab.

The Minor Labels Group

Select the **Enable Minor Labels** check box to display minor tick labels.

Select the **Minor Labels on Major Ticks** check box to display both a minor tick label *and* a major tick label for each major tick. This option is only meaningful for time series labels, in which you specify different tick label types for major and minor tick marks. For example, month and day.

To view both labels in the graph, type a value in the **Offset Major by %** text box. The major tick labels move the specified distance *away* from the center of the page, in units of % of font height.

The Other Options Group

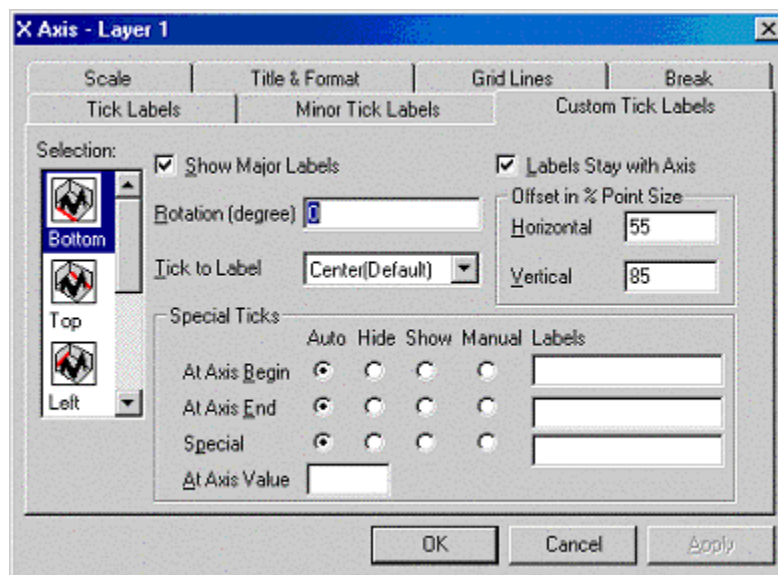
Select the **Box Around Labels** check box to draw a box around each tick label.

Select the **Plus Signs** check box to display a plus “+” sign to the left of positive tick labels.

Select the **Minus Signs** check box to display a minus “-” sign to the left of negative tick labels.

The Custom Tick Labels Tab

Custom Tick Labels Controls



The Selection List Box

Horizontal	This is, by default, the bottom and top X axes. However, if you have exchanged the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Horizontal icon is associated with the left and right Y axes.
Vertical	This is, by default, the left and right Y axes. However, if you have exchanged

	the X and Y axes (Graph:Exchange X-Y Axis) or if you are editing an axis of a bar, floating bar, or stacked bar graph, then the Vertical icon is associated with the bottom and top X axes.
Z Axes	This is, by default, the front and back Z axes.
Bottom	This is, by default, the bottom X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Top	This is, by default, the top X axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Left	This is, by default, the left Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Right	This is, by default, the right Y axis (except if the X and Y axes have been exchanged or if you are editing bar-style graphs).
Front	This is, by default, the front Z axis.
Back	This is, by default, the back Z axis

After you finish editing the properties of an axis, you can begin editing any other axis in your graph by selecting the appropriate icon from the **Selection** list box. To prevent your selections from applying to your graph, click the **Cancel** button at any time during the editing process (but before clicking **Apply**).

The Show Major Labels Check Box

Select the **Show Major Labels** check box to display major tick labels. The major tick label display is also controlled on the **Tick Labels** tab and on the **Minor Tick Labels** tab.

The Rotation (degree) Text Box

Origin supports arbitrary rotation of tick labels. Type a positive number in this text box to rotate labels counterclockwise, and a negative number to rotate labels clockwise.

If you are not using one of the vector fonts or TrueType fonts supplied with Windows 95 (or later) or Windows NT, or a typeface scaling software such as Adobe Type Manager, the rotated labels will not display on the screen. They will, however, print correctly (provided the output device supports text rotation).

The Tick to Label Drop-down List

Select **Next to Ticks** to align the left edge of the tick labels with the major ticks.

Select **Center Between Ticks** to locate tick labels equidistantly between adjacent major ticks.

Select **Center** (Default) to center the tick labels with the major ticks.

The Labels Stay with Axis Check Box

Select this check box to ensure that tick labels always draw adjacent to the axis. When this check box is cleared, the tick labels remain in their default position, even if the axis position is altered.

The Offset in % Point Size Group

Type the desired value in these text boxes to control the horizontal and vertical position of the tick labels relative to the axis (100%=one full font width).

The Special Ticks Group

Up to three tick labels can be customized for each axis: the first major tick (At Axis Begin), the last major tick (At Axis End), and/or at a user-specified (Special) axis value.

The At Axis Begin Radio Buttons

Auto: The default tick label display settings are used.

Hide: If there is a tick label displayed at this value, hide it. Otherwise, do nothing.

Show: If no tick label is displayed at this value, show one. Otherwise, do nothing.

Manual: Display the contents of the Labels text box at this axis value. Use the **%1** notation to include the current tick label at any point in the expression. For example, if the current tick label reads “19”, type **%199** in the Labels text box to display “1999”. Use the **\$(x)** notation to include the current tick label in a calculation, where x is the current tick label value. For example, if the current tick label is “99”, type **\$(1900+x)** to display “1999”.

The At Axis End Radio Buttons

Auto: The default tick label display settings are used.

Hide: If there is a tick label displayed at this value, hide it. Otherwise, do nothing.

Show: If no tick label is displayed at this value, show one. Otherwise, do nothing.

Manual: Display the contents of the Labels text box at this axis value. Use the **%1** notation to include the current tick label at any point in the expression. For example, if the current tick label reads “19”, type **%199** in the Labels text box to display “1999”. Use the **\$(x)** notation to include the current tick label in a calculation, where x is the current tick label value. For example, if the current tick label is “99”, type **\$(1900+x)** to display “1999”.

The Special Radio Button and At Axis Value Text Button

Show, hide, or specify a **Special** tick label at the axis value specified in the **At Axis Value** text box. Origin also adds a major tick mark at this value, if necessary.

Auto: The default tick label display settings are used.

Hide: If there is a tick label displayed at this value, hide it. Otherwise, do nothing.

Show: If no tick label is displayed at this value, show one. Otherwise, do nothing.

Manual: Display the contents of the Labels text box at this axis value. Use the **%1** notation to include the current tick label at any point in the expression. For example, if the current tick label reads “19”, type **%199** in the Labels text box to display “1999”. Use the **\$(x)** notation to include the current tick label in a calculation, where x is the current tick label value. For example, if the current tick label is “99”, type **\$(1900+x)** to display “1999”.

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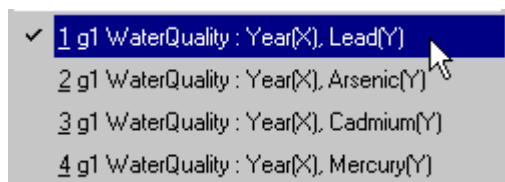
The Graph: Customizing

Data Plots: General Tips

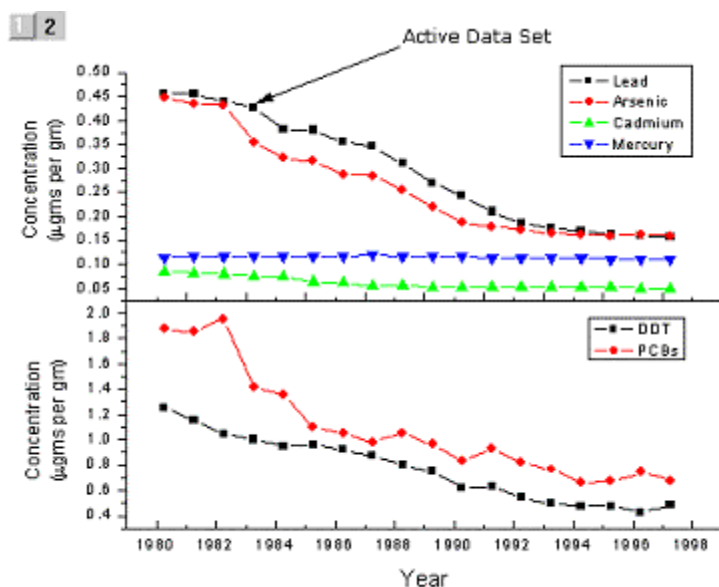
Making a Data Plot Active

Only one graph layer may be active at any given time. Likewise, *only one data plot within a layer* can be active at any given time. A data plot must be made active before you can do such things as change plot color, use the Data Selector tool, fit a curve, or perform any mathematical operation on the data plot.

A **data list** appears at the bottom of the **Data** menu. The list includes all data plots in the active graph layer. A check mark identifies the active data plot in the data list. The data list updates each time you add or remove a data plot from the active layer. Since the list shows only those data plots in the *active* layer, the entire list changes whenever you switch the active layer.



In [this example](#), layer 2 is the active layer; the active data plot is **Lead(Y)** - the data set with the check mark next to it in the above figure.



To change the active data plot, do one of the following:

1. Select the data plot from the data list at the bottom of the **Data** menu.
- or
1. Right-click in the layer and select the data plot from the data list at the bottom of the shortcut menu.

or

1. Right-click on the layer icon and select the data plot from the data list at the bottom of the shortcut menu.

or

1. Right-click on the desired data plot in the graph and select **Set as Active** from the shortcut menu (the shortcut menu command is grayed-out if the data plot is already active).

or

1. Right-click on the desired data plot in the graph and select the primary data set name (**Worksheet_dataset**) for the data plot from the bottom of the shortcut menu.

or

1. Click on the data plot type icon in the legend (if the **Indicate Active Dataset** check box is selected on the **Legend** tab of the **Plot Details** dialog box for the graph page (**Format:Page**)).



The Plot Details Dialog Box and the Editing of Data Plots

Controls for the most elements of the data plot -- the data points, data plots (including data labels and error bars), functions, layers, and the graph page -- are in the multi-tabbed **Plot Details** dialog box. Tab display (and the suite of available controls) is dependent upon:

- The plot type.
- The program's focus in the graph page's Page > Layer > Data Plot > Data Point hierarchy.

Because the Plot Details dialog box provides controls for so many elements in the graph, it can be opened a variety of ways. The following operations open the Plot Details dialog box *with the data plot controls* -- the tabs and options that affect the characteristics of the data plot -- active. To open the Plot Details dialog box:

1. Double-click on the data plot in the graph window.

or

1. Right-click on the data plot.
2. Select **Plot Details** from the shortcut menu.

Note that if you right-click in the layer, but not on a data plot, Origin opens the Plot Details dialog box for the first data plot in the **Data** menu data list.

or

1. Double-click on the data plot type icon displayed on the left side of the graph legend (double-clicking on the legend text opens the **Text Control** dialog box).

or

1. Right-click in the layer containing the data plot.
2. Select **Plot Details** from the shortcut menu.
3. On the left side of the Plot Details dialog box, click to select the icon for the data plot of interest.

Note that if the data plot is part of a group in which the display properties between data plots are incrementing, Origin only allows you to select the first data plot icon of the group.

or

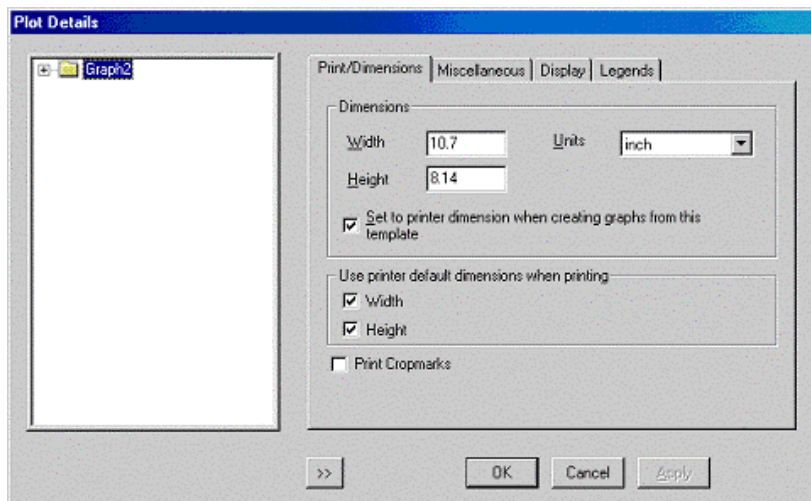
1. Click on the graph window to make it the active window.
2. Select **Format:Plot**.
3. On the left side of the Plot Details dialog box, click to select the icon for the data plot of interest.

or

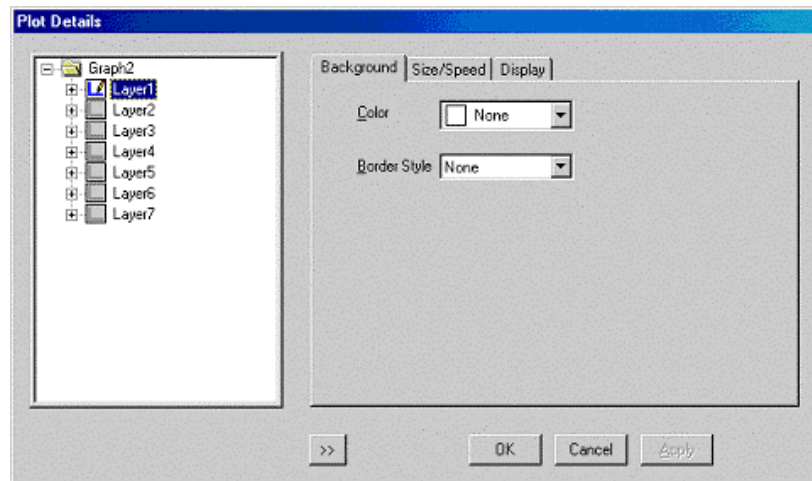
1. Click on the graph window to make it the active window.
2. From the menu, choose **Data** and CTRL + click on any data plot in the data list.

Once the Plot Details dialog box is open, you can activate any Plot Details-accessible control -- regardless of how you opened the dialog box -- by selecting the various components in the tree structure on the left side of the dialog. You then expand the tree on the left side of the dialog box by clicking on the plus signs (+) to expose additional graph elements. For example:

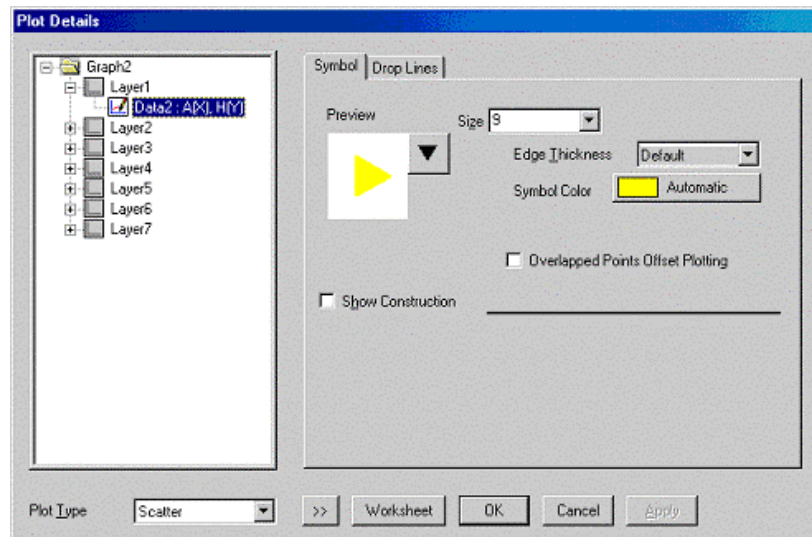
- If you open the Plot Details dialog box by double-clicking outside of the page, the dialog box displays the controls that pertain to the graph page. Note the tab headings on the right-hand side of the dialog box:




- If you click on the plus sign next to the graph icon on the left side of the dialog box and select a layer icon, the dialog box displays the controls that pertain to the graph layer. Note the tab headings on the right-hand side of the dialog box:




- If you click the plus sign next to a layer icon, the tree expands to list the data plots in the layer. You can then click on a data plot icon to display controls relevant to the data plot. Note the tab headings on the right-hand side of the dialog box:



To hide the tree structure, click the  button at the bottom of the Plot Details dialog box.

To redisplay the tree structure, click the  button at the bottom of the Plot Details dialog box.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Switching Between Graph Types

If you plotted your data using a particular graph template (for example, a scatter plot template), Origin allows you to change your graph type selection -- within limits -- from the Plot Details dialog box or directly from the graph window. To change the graph type, do one of the following:

1. Make a data plot active, then click the desired graph type button on the **2D Graphs**, the **2D Graphs Extended**, or the **3D Graphs** toolbars.

or

1. Open the Plot Details dialog box and select the desired data plot icon from the left side of the dialog box.
2. Select one of the listed types in the **Plot Type** drop-down list.

or

1. Right-click on the data plot and select **Change to:Graph Type** from the shortcut menu.

When you switch graph types using one of the above methods, Origin *does not* use the default template associated with the *new graph type* button. Instead, Origin modifies the data plot properties of the existing graph template.

For example, if your current graph is a customized line and symbol plot with blue symbols and red lines, and you click the **Scatter** button on the 2D Graphs toolbar, Origin continues to display the symbols with blue color in the scatter data plot. Furthermore, if you then click the **Line+Symbol** button on the 2D Graphs toolbar, Origin again displays the data plot with blue symbols and red lines. When you switch graph types using one of these methods and the selected data plot is part of a data plot group, each of the data plots in the group changes to the *new graph type*.

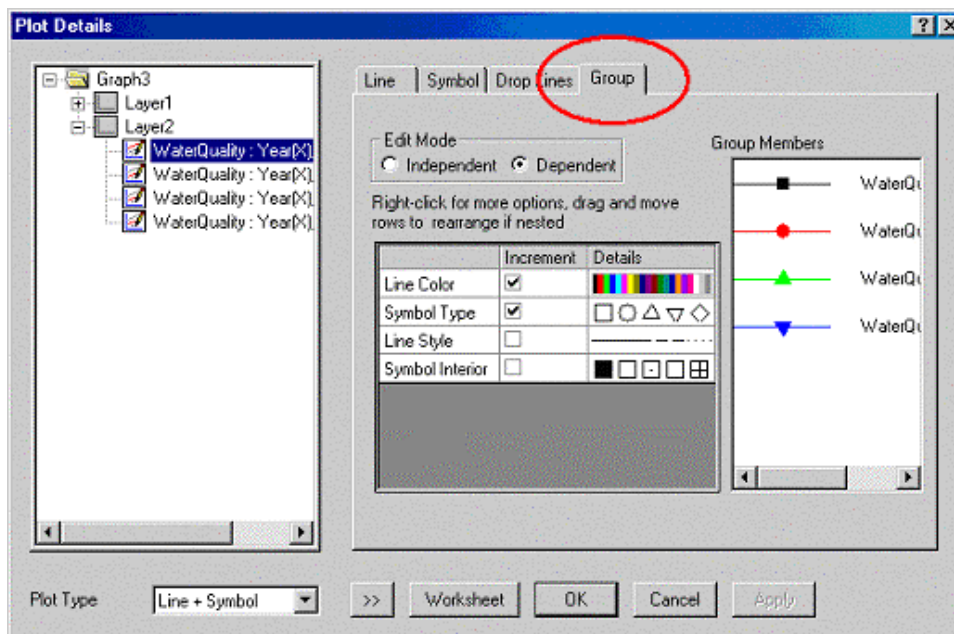
Origin does not allow switching among all graph types. For example, Origin prohibits switching between a line data plot and a ternary data plot because of differing data requirements; the line data plot requires XY values and the ternary data plot requires XYZ values.

In the Plot Details dialog box and the data plot shortcut menu methods (the second and third methods listed above), Origin only lists the graph types that support this switch. If using the toolbar button method (first in the above list), Origin opens an Attention box informing you that the switch is not supported.

Controlling the Display Properties of Grouped Data Plots

When data plots are grouped in the layer, Origin, by default, sets the display properties of each data plot automatically. However, it is possible to customize grouped data plots through the **Plot Details** dialog box and using the color list options on the **Style** toolbar.

If you open the **Plot Details** dialog box and select a data plot icon (on the left side of the dialog box) that is part of a data plot group, the right side of the dialog will display a **Group tab**. The controls that appear on this tab will vary depending on the graph type and the display options that have been made on other Plot Details dialog box tabs.



It is important to understand the functioning of the **Edit Mode (Dependent/Independent)** radio buttons. If you leave the **Dependent** radio button selected (the default data plot group setting), you are prevented from selecting any of the subordinate data sets in the data list on the left side of the Plot Details dialog box. This is because the properties of subordinate plots are controlled by the plot characteristics of the first plot in the list and the order of options -- colors, symbol shapes, etc. -- in the increment lists applied to the plot group.

If you wish to modify the properties of grouped data plots, you can take one of two approaches:

- You can choose the **Independent** radio button, in which case you are free to edit the display properties of any data set; subsequently, changes to the appearance of any plot will not affect, nor be affected by, the order of data sets in the plot group or by incremental lists of colors, symbol shapes, line types, fill patterns, etc.
 1. Right-click inside the graph's layer frame.
 2. From the shortcut menu, choose **Plot Details**. The Plot Details dialog box opens to the **Group** tab.
 3. In the Edit Mode group, select **Independent**.

You are now able to customize the display properties of any data plot in the group. Note that when you select the Independent radio button, the increment controls for the grouped data plots are removed from the Plot Details dialog box. You can freely edit the display properties of any data set in the plot group and editing the display properties of the *first* data plot in the data list will no longer affect the display properties of other grouped plots.

- You can modify or create your own **Group Incremental Lists**, using only the colors, symbol shapes, line types, etc. that you wish to use, but still allow plot display properties to be determined automatically according to the ordering of those lists.

For most, the use of Group Incremental Lists will prove the more satisfactory solution. In addition to creating your own incremental lists, you have control over the *way* in which properties are incremented, as you can choose between **Concerted** or **Nested** incrementing behaviors.

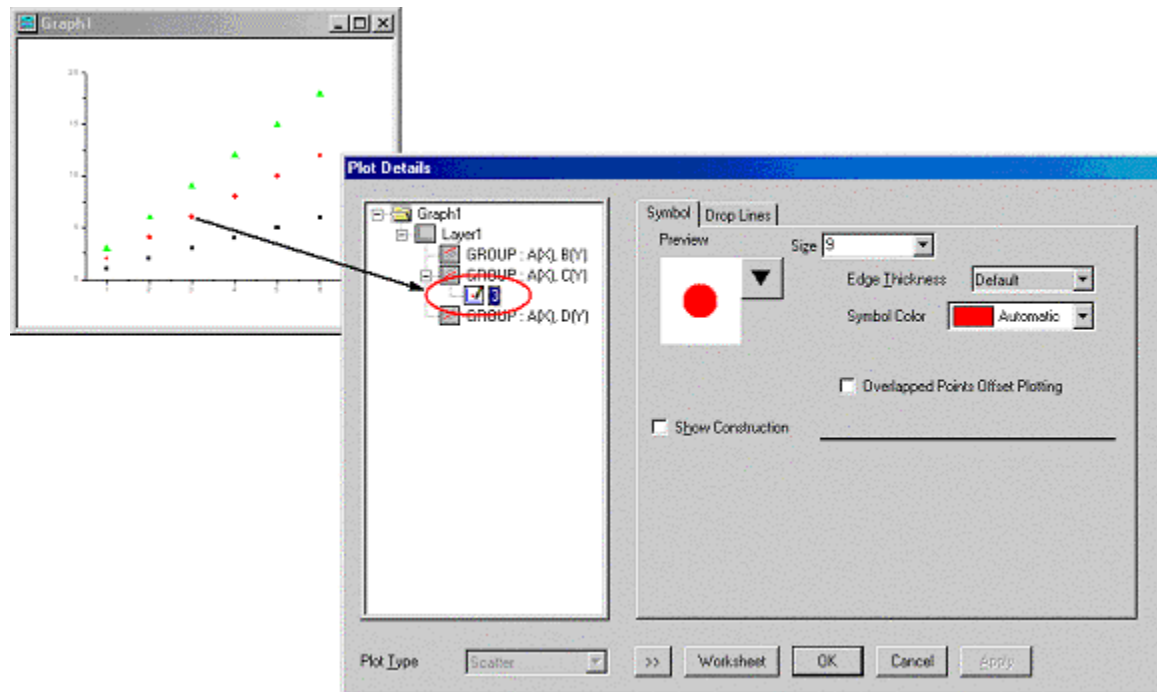
To learn more about managing increment lists, see *Group Incremental Lists* on page 358.

Controlling the Display Properties of a Data Point

You can modify the display properties of an individual data point, even if it is part of a data plot group.

To modify the display of an individual data point:

1. Hold the CTRL key down and double-click on the data point. This opens the **Plot Details** dialog box for this particular data point.
2. Edit the data point display properties, as needed, and click **OK**.



Note that the tree on the left side of the Plot Details dialog box displays a **data point** icon beneath the associated **data plot** icon. The worksheet row index number of this data point displays to the right of the icon.

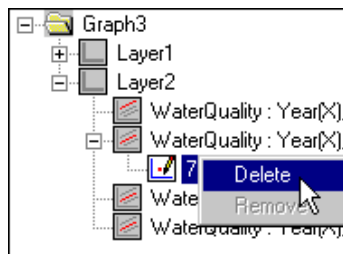
If an individual data point is edited in this fashion, the data point becomes an Origin object. Subsequently, if you double-click on the same data point (*without* holding down the CTRL key), the Plot Details dialog box opens with the data point controls displayed.

To remove the object status from the data point:

1. Click once on the data point to select it (a selection handle will appear) and press the DELETE key.

or

1. Right-click on the data point and select **Delete** from the shortcut menu.



The data point is not deleted. Its object status is merely removed and the display properties of the data point revert to those of the data plot.

Moving a Data Point

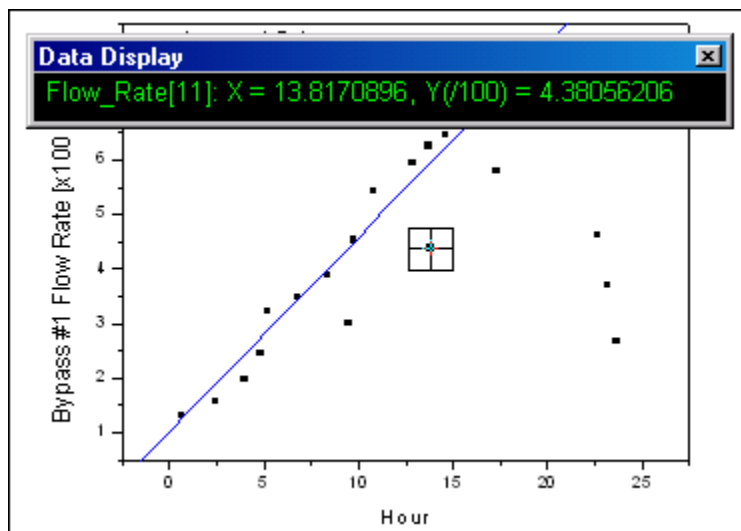
To move a data point in the active data plot:

1. Select **Data:Move Data Points**. If this menu command has not previously been selected for the data plot, an Attention dialog box opens stating that the data plot is not set to have movable data points.
2. Click **Yes** to enable the option. A cursor appears on a data point in the data plot. The **Data Reader** tool also becomes active and the **Data Display** tool opens.
3. Click on the desired data point and drag it to a new location using your mouse.

or from the keyboard...

3. Use the ← and → keys to select the active data point. The ↑ and ↓ keys move the active data point up and down. Use the CTRL in combination with the ← (and →) keys to move the active data point left and right.

The Data Display tool displays the XY coordinates of the selected data point.



When you have moved the point to the desired position, do one of the following to complete your edit:

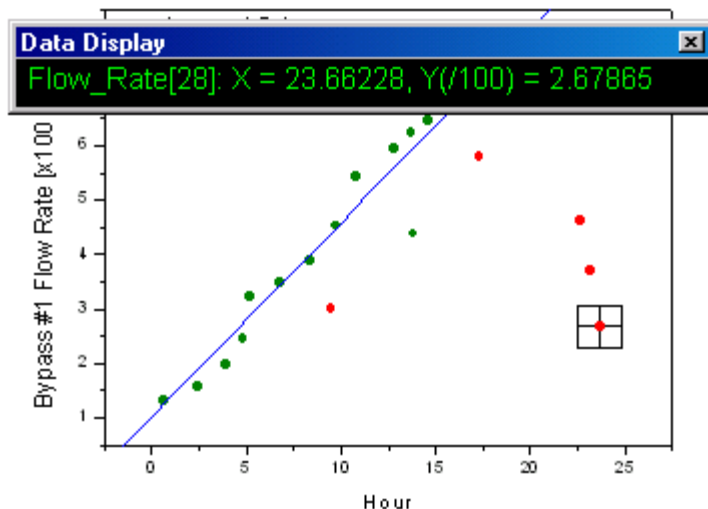
- Press ESC.
- Click on the **Pointer** tool  (the **Tools** toolbar).
- Press ENTER.

The new XY value of the data point is also modified in the worksheet.

Deleting a Data Point

To delete a data point from the active data plot:

1. Select **Data:Remove Bad Data Points**. After selecting this menu command, the **Data Reader** tool becomes active and the **Data Display** tool opens.



To delete a data point...

2. ... click on the desired data point and press ENTER.

or

2. ... double-click on the desired data point.

The data point is deleted from the data plot as well as from the worksheet cell. In the worksheet, all values below the deleted value shift up one row in the column.

Displaying the Data Plot's Worksheet Data

To display the worksheet associated with a data plot, perform one of the following operations:

- Right-click on the data plot and select **Go to Worksheet** from the shortcut menu.
- Double-click on the data plot to open the Plot Details dialog box and click the **Worksheet** button.

Origin opens the worksheet containing the data for the data plot. If no worksheet exists, Origin creates the worksheet. If the worksheet exists but is "filed" in a different Project Explorer folder than the graph, Origin opens the worksheet in the current (graph) folder. To remove the display of the worksheet in the graph folder, make the worksheet's Project Explorer folder active, and then re-select the graph folder.

Ways to Increase Redraw Speed

Origin provides various methods to increase the redraw speed of the active graph window as well as the redraw criteria of the non-active graph windows in your workspace. These tools are most helpful when working with graph windows that:

- are supported by a large amount of data.
- have large numbers of annotations.
- have numerous layers.

or

- your workspace contains many graph windows.

Ways to increase screen redraw speed:

The Origin Basics section discusses the use of a less-accurate (but faster) video mode.

Another way you can improve screen redraw speed is to control redrawing of non-active graph windows in your workspace. When you are customizing a single graph window, there is no need to continually redraw every window in your workspace.

Another way to improve the redraw speed of the active graph window is to hide graphic elements in the graph window. For example, if your graph window contains multiple layers - but you are only editing one layer - you could temporarily hide the other layers while you are editing.

At the graph *layer* level, Origin provides a couple of other controls for increasing the redraw speed:

- **Speed Mode** lets you specify the maximum number of data points that can display for each data plot in a layer. This has the dual benefit of increasing redraw speed and allowing you to systematically filter the number of data points in your plot (think, for instance, about the difficulty of creating a legible scatter graph of one million data points). To learn more, see *Speed Mode* on page 298.
- **Graphic image caching** lets you use vector or raster buffering to display data plots in a layer, instead of having Origin redraw the data plots each time the graph window is made active, or when a dialog box is closed that was covering the data plots.

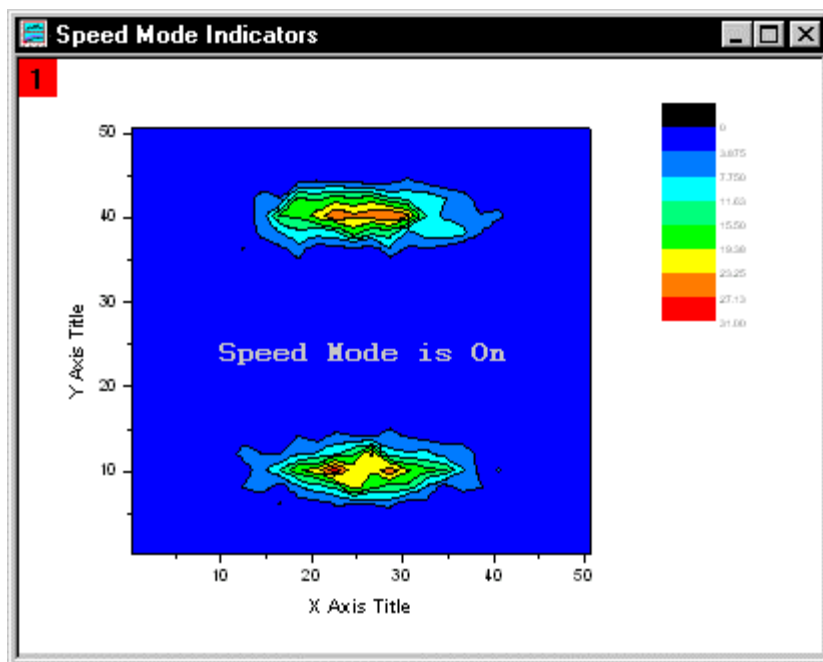
Speed mode and graphic image caching controls are on the **Size/Speed** tab of the layer's Plot Details dialog box.

Speed Mode

In addition to graphic image caching, you can use Origin's **Speed Mode** to increase the redraw speed of your graph layer. With speed mode, you can control the number of data points displayed in a graph layer.

This option is most useful when working with large data sets. Speed Mode can be applied to any 2D or 3D graph.

When Speed Mode is enabled, *the layer icon displays in red* and a **Speed Mode is On** watermark appears in the layer. The watermark is *not included when printing, copying, or exporting* the graph.




To adjust Speed Mode settings:

1. With your graph active, select **Format:Layer** from the Origin menu.
2. Select the **Size/Speed** tab.
 - For plots created from worksheet data:
 1. Select the **Worksheet Data, Maximum Points Per Curve** check box to enable speed mode for all the data plots in the layer that are created from worksheet data.
 2. Type the desired value (n) in the associated text box. If the number of data points in a data plot exceeds n, Origin displays a subset of the data plot containing n points, drawn by extracting values at regular intervals from the data set.
 - For 3D data plots created from a matrix or for contour data in the layer:
 1. Select the **Matrix Data, Maximum Points Per Dimension** check box to enable speed mode.
 2. Type the desired value (n, m) in the X and Y text boxes. If the number of data points in a data plot exceeds n or m, Origin displays a subset of the data plot composed of -- at maximum -- n by m points. This subset is drawn by extracting values at regular intervals from the matrix columns (X) and rows (Y).

To turn off the **Speed Mode is On** watermark:

1. Select **Tools:Options** to open the Options dialog box.
2. Select the **Graph** tab and clear the **Speed Mode Show Watermark** check box.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Note1: The Speed Mode settings as applied on the Size/Speed tab of the layer's Plot Details *only apply to what you see on screen*. They do not apply to graphs that are printed or exported.

If you wish to apply Speed Mode settings to *printing*, see page 432 (*The Print Dialog Box*) for a discussion of the **Skip Points** option.

If you wish to apply Speed Mode settings to *graphic export*, see the discussion of the **Performance Group** controls (*The Plot Details Miscellaneous tab*) on page 301.

Note2: All Speed Mode settings are saved with the graph template. If you wish to make changes to Speed Mode settings permanent, you must resave the graph template once changes are made.

Note3: You should always exercise caution when applying Speed Mode settings. Since Speed Mode systematically removes a portion of your data points, it should be kept in mind that any graph in which Speed Mode is turned on, may -- or may not -- accurately represent your entire data set. Always familiarize yourself with your data and adjust and compare Speed Mode settings to ensure that your data are accurately represented.

Controlling the Display of Elements Associated with the Page

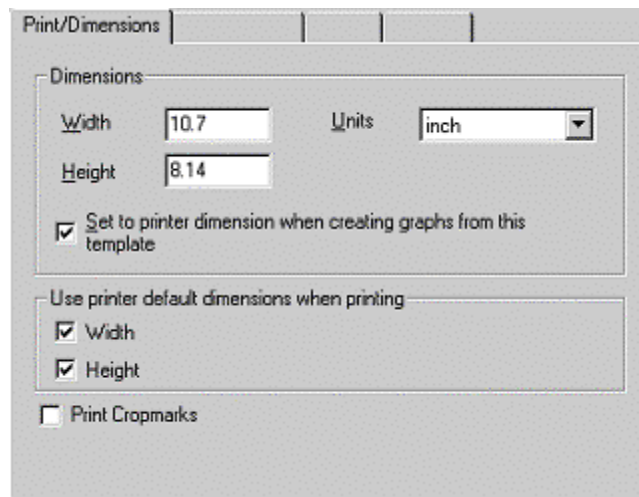
Setting the Dimensions of the Graph Page

Settings on the Print/Dimensions tab control the graph page size and the printing of crop marks for printing graphs across multiple sheets.

To open the (Plot Details) **Print/Dimensions** tab:

1. With the graph active, select **Format:Page**. This opens the Plot Details dialog box.
2. Select the Print Dimensions tab if it is not already selected.

The (Plot Details) Print Dimensions Tab Controls



The Dimensions Group

Enter **Width** and **Height** in **Units**.

Select **Set to Printer Dimension when Opened from a Template** to reset page dimensions to those of the currently-selected printer when creating graphs from this template (By default, this is checked for all Origin built-in templates). If you clear this check box and save the active graph window as a template, when you next create a graph window from this template, page dimensions will be determined by the **Width** and **Height** settings at the time the template was saved.

The Use Printer Default Dimensions When Printing Group

You can print a graph page that is *smaller* or *larger* than the current printer driver's "printable area."

- A graph page with dimensions that are smaller than those of the printable area will print on one page. The upper-left corner of the graph will be positioned in the upper-left corner of the printable area.
- A graph page with dimensions that are larger than those of the printer page will print across multiple pages (see the **Print Cropmarks** check box).

To ensure that the **Width** and/or **Height** text box values in the **Dimensions** group control the size of the printed graph, clear the **Width** and/or **Height** check boxes in the **Use Printer Default**

Dimensions When Printing group. Otherwise, Origin will adjust the graph page to fit the printer page, independent of the **Dimensions** group settings.

For example:

If the **Width** of a graph page is set to 20 inches and the **Height** is set to 8 inches, while the printer page **Width** is 10 inches and the **Height** is 8.5 inches, and the **Width** check box (**Use Printer...**group) is cleared but the **Height** check box is selected, Origin will print the graph across two pages (because $20 \text{ inches} / 10 \text{ inches} = 2$).

The controls in this group are also accessible when printing. To access them when printing, select **File:Print** and then click the **Options** button. Edit the **More Print Options** dialog box as desired. Note that when you edit the controls in the **Plot Details** dialog box, information in the **More Print Options** dialog box is updated. Similarly, when you edit the controls in the **More Print Options** dialog box, the **Plot Details** dialog box is updated.

The Print Crop Marks Check Box

Select this check box to display crop marks at the margins of the printer's printable area.

Note: You can also print crop marks by selecting the **Print Crop Marks** check box in the **More Print Options** dialog box (click the **Options** button on the **Print** dialog box).

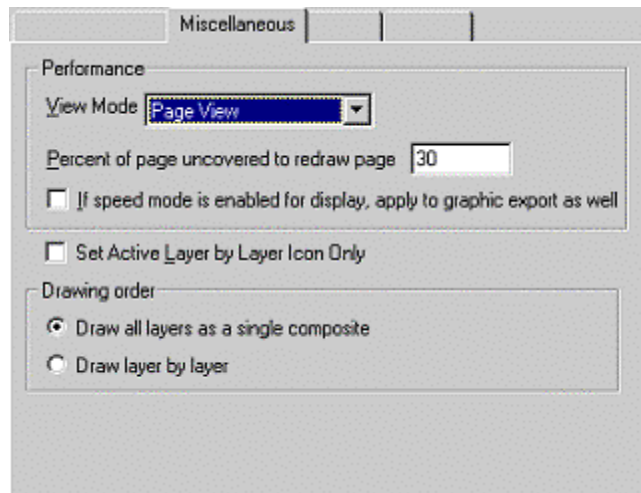
The (Plot Details) Miscellaneous tab

The **Miscellaneous** tab of the page's **Plot Details** dialog box provides control of the view mode and the redraw criteria of a graph window (when it is non-active), the application of speed mode settings to graphic export (includes graphs copied to the Clipboard), and layer activation by the layer icon only.

To open the (Plot Details) **Miscellaneous** tab of the Plot Details dialog box:

1. With the graph window active, select **Format:Plot** from the Origin menu. This opens the Plot Details dialog box.
2. Select the **Miscellaneous** tab.

The (Plot Details) Miscellaneous Tab Controls



The Performance Group

Select **View Mode** drop-down list. Options: **Print View**, **Page View**, **Window View**, and **Draft View**. This option is identical to selecting **View:View Mode**.

The **Percent of Page Uncovered to Redraw Page** text box controls the redraw criteria of the graph window when it is *not* active. Units are in % of page. Enter a redraw threshold value *n*; if more than *n*% of the graph page is uncovered, the graph window will redraw when the active window on top of it is moved. For a more detailed discussion of this setting, see *Controlling the Graph Window Redraw Conditions* on page 302.

The **If Speed Mode is Enabled for Display, Apply to Graphic Export as Well** check box allows you to apply speed mode when your graph is exported to a file or copied to the Clipboard. Speed mode is set on the **Size/Speed** tab of the layer's **Plot Details** dialog box. Enabling speed mode increases the redraw speed of your graph layer by limiting the number of data points displayed in that graph layer.

The Set Active Layer by Layer Icon Only Check Box

Select this check box to ensure that a layer can be made active only by clicking on the layer icon.

The Drawing Order Group

Draw All Layers As a Single Composite forces display of data in both layers even if one or both layers have a background color.

Draw Layer by Layer will draw layer 2 after completely drawing layer 1, including the layer 1 background. If you specify a background color for layer 2 by selecting layer 2 from the tree structure in Plot Details, and choosing a color on the Background tab, then the background in the second layer will mask elements of the first layer. If you leave the background as None then the data in layer 1 will be visible in layer 2.

Controlling the Graph Window Redraw Conditions

When you are making changes to a graph window, and your workspace includes additional graph windows, you can prevent the non-active graph windows from redrawing as you make changes to the active graph window. Preventing the non-active graph window from redrawing can save you considerable time, in some cases:

- If you are editing the Plot Details dialog box for a particular graph window, and this dialog box obscures part or all of a *non-active* graph window, you may not want the non-active graph window to redraw (not to be confused with "refreshed" in which case, a graph is actually changed/updated) after you close the Plot Details dialog box.
- Similarly, if your workspace includes a number of graph windows, and the active graph window is covering part or all of a non-active graph window, you may not want the non-active graph window to redraw when you move your active graph window in the workspace.

To control the redraw criteria of a graph window (when it is non-active):

1. Select **Format:Page** when the graph window is active.

or

1. Double-click in the gray area outside of the graph page.

Both actions open the Plot Details dialog box with the graph page icon selected on the left side of the dialog box.



2. Select the **Miscellaneous** tab on the right side of this dialog box. The **Percent of Page Uncovered to Redraw Page** text box controls the redraw criteria of this graph window *when it is non-active*. The text box is in units of % of page.
3. Type a redraw threshold value n , so that if more than $n\%$ of the graph page is *uncovered*, the graph window will redraw when:
 - The active graph window that is on top of the non-active graph window is moved.
 - A dialog box that was covering this non-active graph window is moved or closed.

The smaller that n is, the *more* frequently the graph window is redrawn.

Setting the Page Color and Other Page Display Preferences

To set a page color, or to enable the display of a data plot line connection across axis breaks and missing data:

1. Select **Format:Page** when the graph window is active.

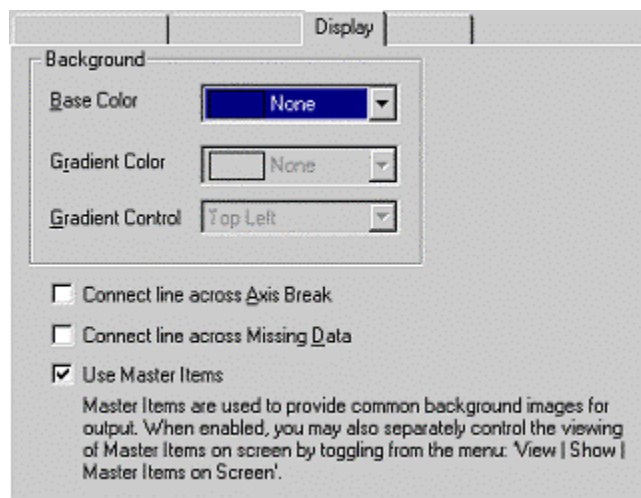
or

1. Double-click in the gray area to the right of the graph page.

Both actions open the **Plot Details** dialog box with the graph page icon selected on the left side of the dialog box.

2. Select the **Display** tab on the right side of this dialog box.

The (Page) Display Tab on the Plot Details Dialog Box



The Background Group

To display no page color:

1. Select **None** from the **Base Color** drop-down list.

When None is selected and the page is exported or copied to the Clipboard, the page is transparent (displays the background color of the host application).

To display a single color on the page:

1. Select a **Base Color**.

To display a *gradient* of colors on the page:

1. Select the **Base Color** and **Gradient Color**.
2. Specify the location for the Base Color from the **Gradient Control** drop down list.

The Connect Line Across Axis Break Check Box

To connect the clipped ends of a line or a line+symbol data plot at an axis break:

1. Select the **Connect Line Across Axis Break** check box.

In a line+symbol data plot, the line across the break region displays as a dashed line.

The Connect Line Across Missing Data Check Box

Origin provides an option for connecting lines across missing data in **line** and **line + symbol** data plots.

To enable this option:

1. Select the **Connect Line Across Missing Data** check box.

Controlling the Display of Graph Legends on the Page

The legend is a special Origin text label that identifies each data plot in the associated layer by name and plot type. The data plot name is determined by the name of the worksheet column in which the data set resides. If the worksheet column includes a label, the label is used to create the legend.

Though each legend is associated with a particular layer, controls on the **Legends** tab of the page's Plot Details dialog box control some properties of legends in all the layers on the page.

To open the (Plot Details) Legends tab:

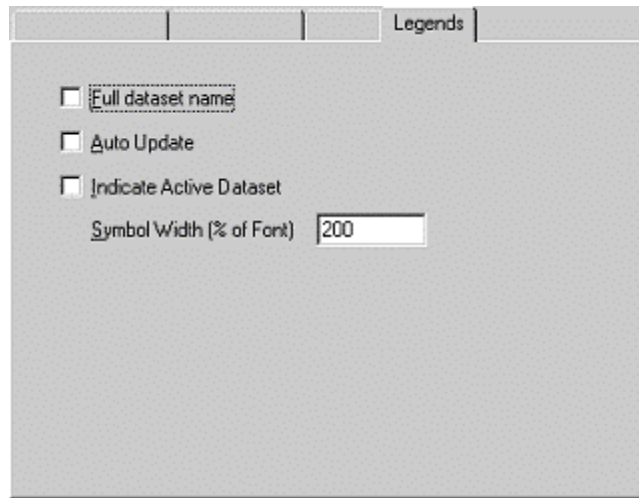
1. Select **Format:Page** when the graph window is active.

or

1. Double-click in the gray area outside of the graph page.

Both actions open the Plot Details dialog box with the graph page icon selected on the left side of the dialog box. Select the **Legends** tab on the right side of this dialog box.

Controls for the (Page) Legends Tab of the Plot Details Dialog Box



The Full Dataset Name Check Box

The default legend displays only the column name for each data set (or the column label, if it exists). To display the full data set name in the legend:

1. Select the **Full Dataset Name** check box.

The full data set name has the syntax *WorksheetName_ColumnName*.

The Auto Update Check Box

Select the **Auto Update** check box to automatically update the legend(s) whenever a data plot is added to, or deleted from, the associated layer on the page. If this check box is cleared, you must manually update the legend for each layer by selecting **Graph:New Legend** when the desired layer is active. Alternatively, right-click in the layer and select **New Legend** from the shortcut menu.

The Include Data Plots from All Layers Check Box

By default, Origin only includes datasets contained in the graph layer that is active when the legend object is created.

Select this box to include *all* datasets in *all* layers in the legend.

To learn more, see *Creating and Updating a Legend* on page 410.

The Indicate Active Dataset Check Box

Select the **Indicate Active Dataset** check box to denote the active data set in the legend. When this check box is selected, a black square surrounds the legend's data plot type icon for the active data plot in the layer.

Additionally, when this check box is selected, the active data plot can be selected by clicking on the data plot type icon in the legend.

Note: You can also select the active data plot from the **Data** menu or from shortcut menus. If you change the active data plot by selecting a data plot from the data list or from a shortcut menu, you must refresh the graph window to reflect the change in the legend.

The Symbol Width (% of Font) Text Box

The value in the **Symbol Width** text box determines the width of the data plot type icon(s) in the legend in % of the legend font size.

Controlling the Display of Elements Associated with the Layer

Displaying a Layer Background Color and Adding a Border

By default, the layer does not display a background color; it is transparent. Any color that is subsequently applied to the graph page also displays in each of the layers that it contains. Controls for adding a layer (background) color and a border, are found on the **Background** tab of the layer's Plot Details dialog box.

To add a background color to a layer:

1. From the menu, choose **Format:Layer**. This opens the **Background** tab of the layer's Plot Details dialog box.
2. Select a color from the **Color** drop-down list (**None** = transparent).

The layer border is a bounding box outside of the layer frame. To display the layer border:

1. Select a **Border Style** from the drop-down list.

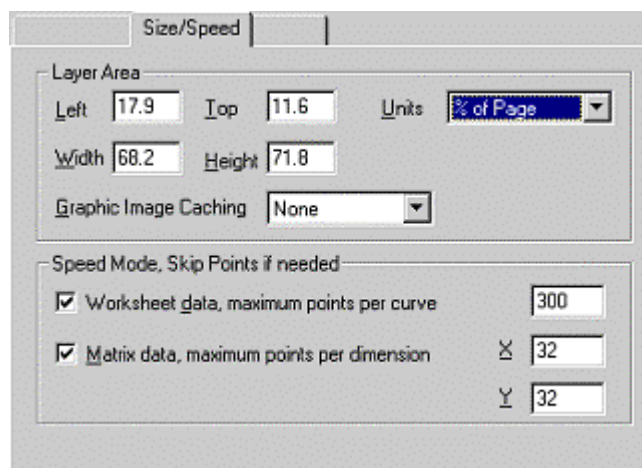
Note that the border can be moved and resized independently of the layer. To move or resize the border:

1. Click on the border line to select it. A highlighted boundary with control handles displays.
2. Move or resize the border in the same way as you would other objects.

Specifying New Layer Dimensions in the Plot Details Dialog Box

The layer dimensions are set on the **Size/Speed** tab of the layer's Plot Details dialog box.

The Plot Details (Layer) Size/Speed Tab Controls



The Layer Area Group

- To Position or Resize the Layer:

To numerically position or resize the layer, type values in the **Left**, **Top**, **Width**, and **Height** text boxes. The **Left** text box value determines the position of the frame relative to the left side of the page. The **Top** text box value determines the position of the frame relative to the top of the page. The **Height** and **Width** text box values determine the size of the frame.

Specify the units with the **Units** drop-down list.

- Specify **inch**, **cm**, **mm**, **pixel** or **point**.
- The **% of Page** unit is useful for maintaining the same layer size relative to the page size. When this unit is selected, the Left, Top, Height, and Width text box values are in percentage of the graph page height and width.
- The **% of Linked Layer** unit is useful for creating inset graphs. This unit allows you to specify the frame dimensions and offsets for a child layer in terms of the dimensions of the parent layer frame. When this unit is selected, the Left, Top, Height, and Width text box values are in percentage of the height and width of the parent layer frame. (This unit is not available unless the current layer is linked to a parent layer.)

Note1: When the unit selection is changed in the drop-down list, the Left, Top, Height, and Width text box values are automatically updated so that the layer retains the same size and position.

Note2: When you set the size of the layer, you are also setting the size of the axes in the layer. To set the layer (and thus the axes) to a specific width and height, select the units (for example, **inch**, **cm**, or **mm**) from the **Units** drop-down list in the **Layer Area** group, then enter the dimensions in the **Width** and **Height** text boxes.

- Graphic Image Caching:

Select a buffering method from the **Graphic Image Caching** drop-down list. Graphic image caching can be used whenever a 2D or 3D graph layer needs to be redrawn without being refreshed. For example, when a graph window is overlaid by a worksheet window and then brought to the front again, or when the graph window is resized. For 2D graph layers, select **Raster** to use caching. For 3D graph layers, select **Raster** or **Vector**.

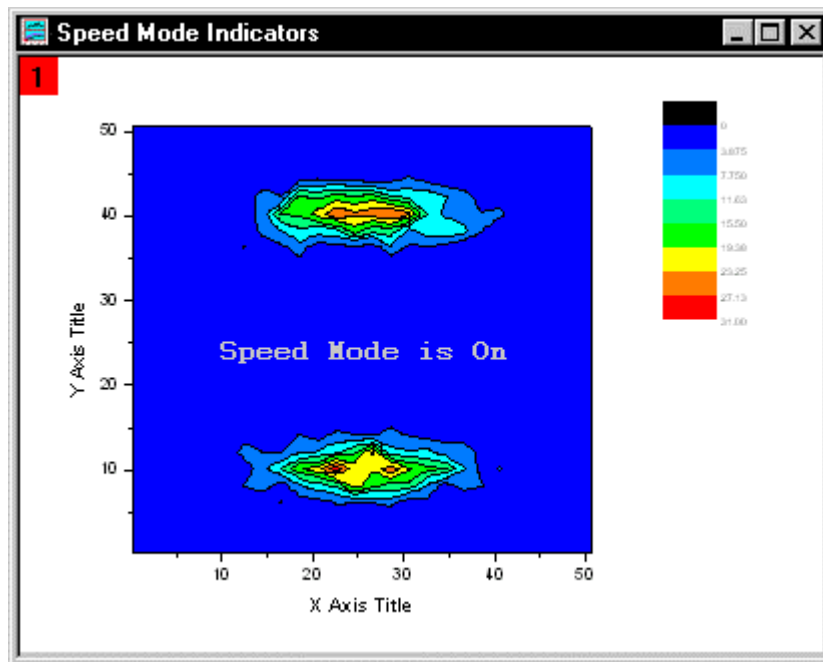
- **Vector** (metafile) buffering provides Origin with a detailed description of how to draw the graph and is fully scaleable.
- **Raster** (bitmap) buffering tells Origin how many pixels of what color to draw at what position. This information is based on a certain resolution and will become distorted when resized.
- If you select **None**, Origin redraws the graph layer every time the graph window is moved, brought to the front, or resized.

Note: If you resize your graph in raster caching mode, the graph may get a rough pixel appearance. If this occurs, select **Window:Refresh** to restore the display.

The Speed Mode, Skip Points if Needed Group

In addition to graphic image caching, you can use Origin's **Speed Mode** to increase the redraw speed of your graph layer. With speed mode, you can control the number of data points displayed in a graph layer. This option is most useful when working with large data sets.

When Speed Mode is enabled, the layer icon displays in red and a **Speed Mode is On** watermark appears in the layer (see illustration). The watermark is *not* included when printing, copying, or exporting the graph. To control watermark display, see the information under the next heading.



- To Adjust Speed Mode settings

1. With your graph active, select **Format:Layer** from the Origin menu.
2. Select the **Size/Speed** tab.

For plots created from worksheet data:

3. Select the **Worksheet Data, Maximum Points Per Curve** check box to enable speed mode for all the data plots in the layer that are created from worksheet data.
4. Type the desired value (n) in the associated text box. If the number of data points in a data plot exceeds n , Origin displays a subset of the data plot that contains n points. This subset contains evenly spaced data - by the worksheet rows.

For 3D data plots created from a matrix or for contour data in the layer:

3. Select the **Matrix Data, Maximum Points Per Dimension** check box to enable speed mode.
4. Type the desired value (n, m) in the X and Y text boxes. If the number of data points in a data plot exceeds n or m , Origin displays a subset of the data plot composed of, at maximum, n by m points. This subset contains evenly spaced data - by the matrix columns (X) and matrix rows (Y).

To turn off the **Speed Mode is On** watermark:

1. Select **Tools:Options** to open the **Options** dialog box.
2. Select the **Graph** tab and clear the **Speed mode show watermark** check box.

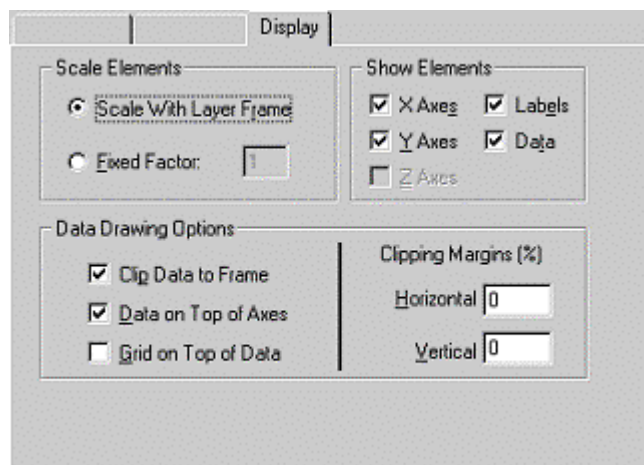
Note: All Speed Mode settings are saved with the graph template. If you wish to make changes to Speed Mode settings permanent, you must resave the graph template once changes are made.

Note: If you are producing graphs for printing or graphic export, be sure to see **Note1** on Speed Mode.

Controlling the Display and Scaling of the Objects in a Layer

The **Display** tab of the layer's Plot Details dialog box provides controls to turn on and off the display of the axes, axes labels, legend, and data in the layer - as well as any other objects that are attached to the Layer Frame or Layer and Scales in their respective Label Control dialog box (**Format:Label Control**). Additionally, you can control the scale of these objects with respect to the layer on this tab.

The Plot Details (Layer) Display Tab Controls



The Scale Elements Group

This group determines how the axes, axes labels, legend, data plots, and other objects that are attached to the Layer Frame or Layer and Scales are affected when the layer is resized.

Select the **Scale with Layer Frame** radio button to scale the layer elements proportionally with the layer.

Select the **Fixed Factor** radio button to determine the scale factor of the layer elements. This scale factor determines the size of the layer elements relative to their original size (font size, symbol size, and line width, etc.). The size of these elements is determined by multiplying their original size by the scale factor when the **Fixed Factor** radio button is selected. Type the desired scale factor in the associated text box.

The Show Elements Group

Clear the **X Axes**, **Y Axes**, and **Z Axes** check boxes to hide the X, Y, and Z axes in the layer (Note that similar controls are provided in the Axis dialog box). If you edit the check boxes on the

Display tab, the controls in the Axis dialog box update to reflect your changes. Similarly, if you edit the check boxes on the Axis dialog box, the controls on the Plot Details dialog box update to reflect your changes.

Clear the **Labels** check box to hide all axis titles, arrows, text labels, shapes, and objects in the active layer. (To view the labels in the printout, remember to select the Labels check box before printing.)

Clear the **Data** check box to hide all data plots in the active layer. (To view the data in the printout, remember to select the Data check box before printing.)

The Data Drawing Options Group

Select the **Clip Data to Frame** check box to hide data that extends beyond the layer frame. If the Clipping Margins settings have been set, select this check box to hide all data outside of the customized clipping margins.

Select the **Data on Top of Axes** check box to display data plots and symbols superimposed over the layer axes.

Select the **Grid on Top of Data** check box to display axis grid lines superimposed over data plots and symbols.

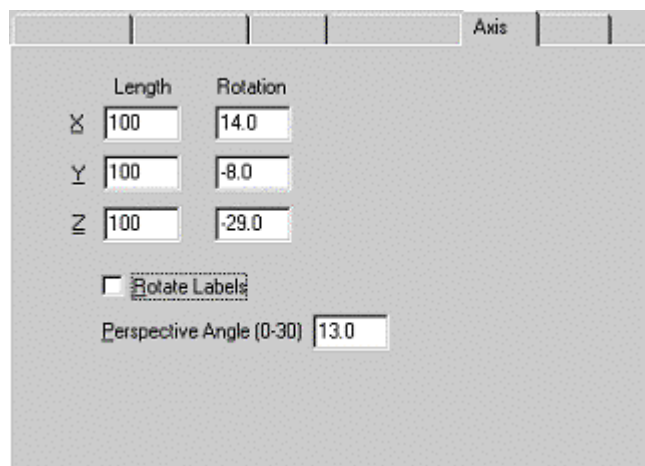
Edit the **Clipping Margins (%)** sub-group to set the clipping margins inside, or outside, the active layer frame. The default units are in % of the layer frame size. Type a negative value to clip the data to a point outside the frame. Type a positive value to clip the data to a point inside the frame. To clip the data, select the Clip Data to Frame check box.

Controlling the 3D Axis Length, Rotation, and Perspective in a Layer

Use controls on the **Axis** tab of the layer's Plot Details dialog box to:

- Specify the X, Y, and Z axes physical length in relation to the layer frame.
- Manually set the rotation angle about the X, Y, or Z axes.
- Change the perspective angle.

The (Layer) Axis Tab on the Plot Details Dialog Box



The **Length** and **Rotation** Text Boxes

Specify the X, Y, and Z axis length in the **Length** text boxes. The text boxes are in units of percent of the layer frame. Thus, to display the X axis at 50% of its full length, type 50 in the X Length text box.

To manually set the rotation angle about the X, Y, or Z axis, type the rotation angle in the **Rotation** text boxes. This text box value is in units of degrees, and is independent of the Angular Unit setting on the Numeric Format tab of the Options dialog box.

You can also use the 3D Rotation toolbar buttons to rotate the graph about the axes.

The **Rotate Labels** Check Box

To rotate the tick labels so that they align with the axes as you rotate the graph, select the **Rotate Labels** check box.

The **Perspective Angle (0-30)** Text Box

In addition to rotating the 3D graph, you can change the perspective angle. When you change the perspective angle you change the effective distance from the observation point. Type the desired perspective angle (in degrees) in the **Perspective Angle** text box. You are limited to a range of 0 to 30 degrees.

You can choose either a *perspective* or *orthographic* projection from the **Miscellaneous** tab of the Layer's Plot Details dialog box.

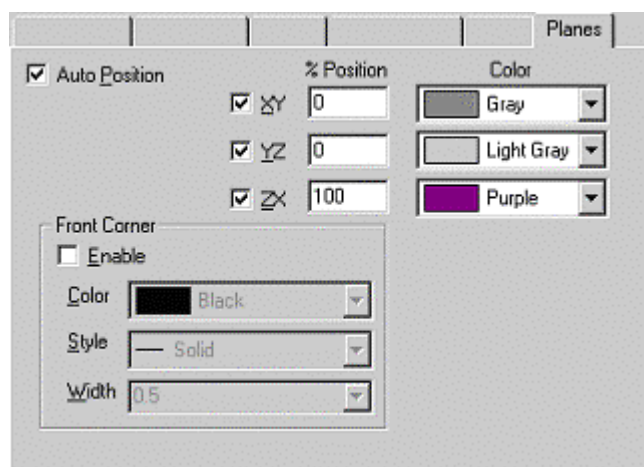
You can also use the 3D Rotation toolbar buttons to change the perspective angle.

Controlling the Display of the 3D Planes in a Layer

In 3D graph layers, you can control the position and display of the **XY**, **YZ**, and **ZX** planes. You can also display the outlines of the front planes in your 3D graphs.

To control the display of the 3D planes, edit the **Planes** tab of the layer's Plot Details dialog box.

The (Layer) **Planes** Tab on the Plot Details Dialog Box



To Specify the Position and Color of the Back Planes

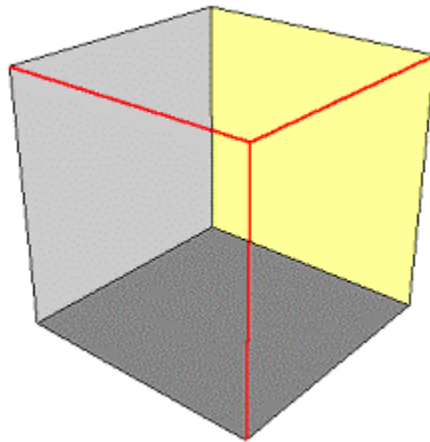
Select the **Auto Position** check box to automatically re-display the back plane when the graph is rotated such that one of the planes shifts to the front. When this event occurs, the **% Position** text

box values update. For example, a text box value displaying 100 before the rotation would display 0 after - if the rotation caused the plane to shift to the front.

To control the position and display color of the **XY**, **YZ**, or **ZX** planes, select the associated check box. The **% Position** text box value controls the position of the respective plane, from the bottom of its orthogonal axis, as a percentage of the axis's length. Select the plane color from the associated **Color** drop-down list.

To Display the Outlines of the Front Planes

In addition to controlling the display of the back planes, you control the display of the outline of the front planes. Selecting this option gives your graph a 3D cube effect. Select the **Enable** check box to display the front plane outlines. Control the line display from the associated controls.



Clipping the Data Plot to the Frame

Data plots that extend beyond the layer frame, or beyond the customized clipping margins, can be hidden from view. To clip the data plot in the active layer:

1. Select **Format:Layer**.

or

1. Double-click on the layer icon to open the associated **Layer *n*** dialog box.
2. Click the **Layer Properties** button.

Both actions open the Plot Details dialog box with the layer icon selected on the left side of the dialog box.

3. Select the **Display** tab and then select the **Clip Data To Frame** check box in the **Data Drawing Options** group. To view the clipped data, clear this check box.

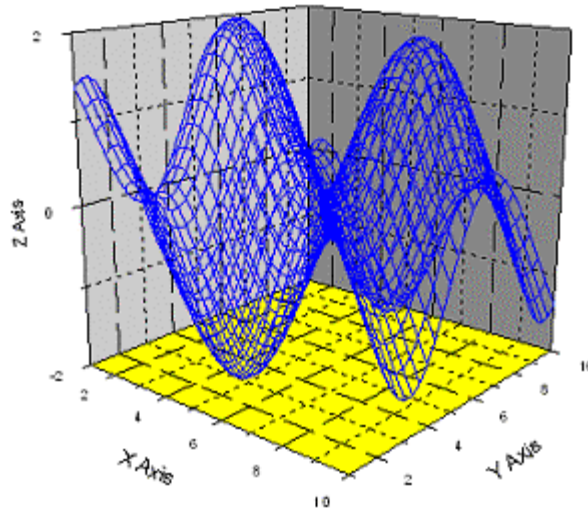
To set the clipping margins inside or outside the active layer frame, type the margin value percentages in the Horizontal and Vertical text boxes in the Data Drawing Options group.

- Type a negative value to clip the data plot to a point *outside* the frame.
- Type a positive value to clip the data plot to a point *inside* the frame.

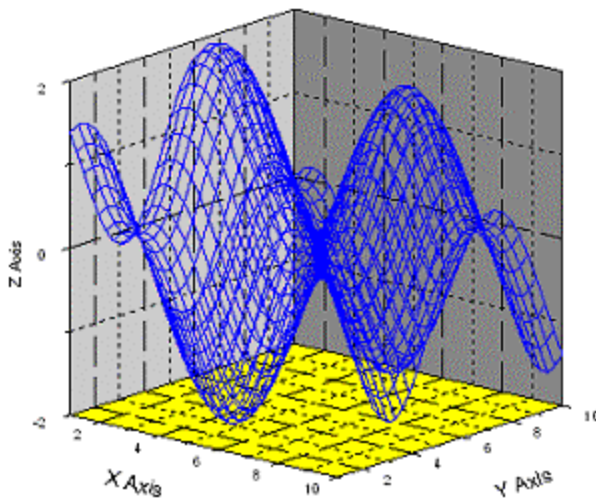
Viewing a 3D Graph with a Perspective or Orthographic Projection

You can control the projection of your 3D graph from the **Projection** drop-down list on the **Miscellaneous** tab of the layer's Plot Details dialog box.

Photographs show a perspective projection. The effect of perspective is to make railroad tracks look narrower in the distance.

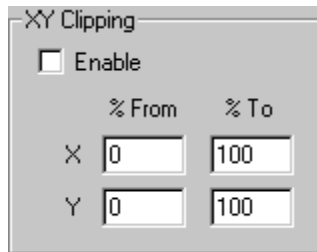


Orthographic projection is an approximation to perspective projection when the viewpoint is located at infinity relative to the objects being imaged. With orthographic projection, there is no distortion of the coordinates of a point. In an orthographic projection, the railroad tracks look parallel.



Hiding Data in the 3D XY Plane

You can specify the plotting range on the XY plane of your 3D graph - *without changing the axis range* - by editing the **XY Clipping** group on the Miscellaneous tab of the layer's Plot Details dialog box.



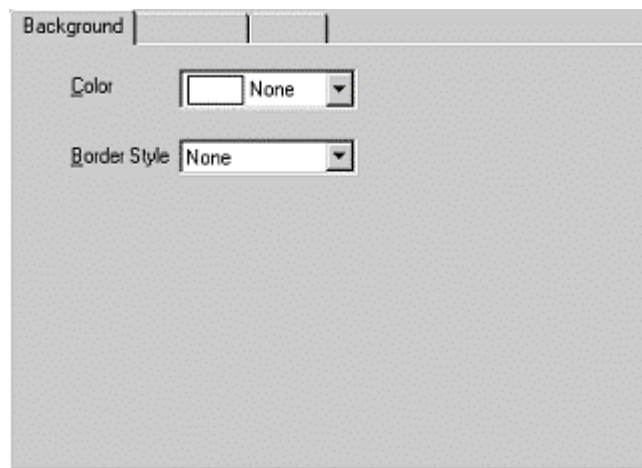
The (Layer) Miscellaneous Tab on the Plot Details Dialog Box

Select the **Enable** check box to hide (clip) all data points with XY coordinates outside the range specified in the **% From** and **% To** text boxes. (Note that the axes will continue to display their current range.) Customize the clipping area by editing these text box values. The text box values are in units of percentage of the axes scales.

The (Plot Details) Background tab

By default, the layer does not display a background color. Rather, its display is transparent. Therefore, any color that is applied to the graph page also displays in each of the layers that it contains.

The (Layer) Background Tab Controls



The Color Drop Down List

To add a background color to a layer, select the desired color from the **Color** drop-down list (**None** = transparent).

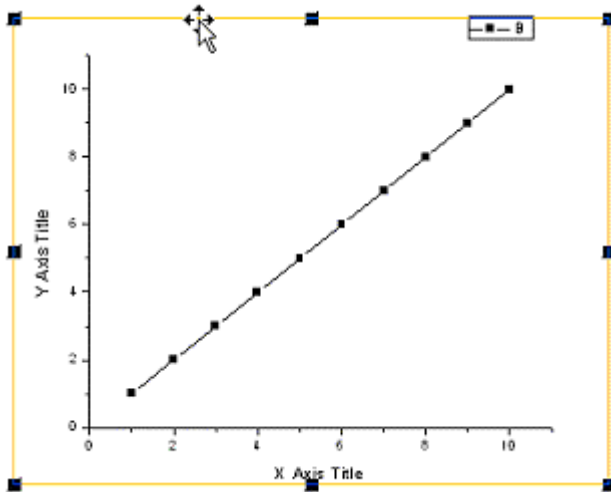
The Border Style Drop Down List

The layer border is a bounding box outside of the layer frame. To display the layer border:

1. Select a border from the **Border Style** drop-down list.

Note that the border can be moved and resized independently of the layer. To do this:

1. Click on the border line to select it. A highlighted boundary with control handles displays.
2. Move or resize the border in the same way as other objects.



Controlling the Display of the Data Plot

Customizing the Colors in Your Data Plot

Plotting Your Data Using a Specific Color

A specific color can be chosen from either color buttons or color drop-down lists. You can choose:

- A color in the color palette.

To specify a color from the color palette, click the color button and select **Individual Color:Color**.

If you're editing a color drop-down list, select the desired color from the drop-down list.

- A custom color

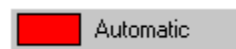
You can create a custom color from the color button options and from *some* of the color drop-down lists. To create a custom color:

1. Click the color button and select **Custom**.
2. Right-click on the **Custom** button to open the **Color** dialog box.

After defining a custom color, the color displays in the **Custom** button.

Some of the color buttons and color drop-down lists include an **Automatic** color option which, when available, is chosen by default. For each color button or drop-down list with this option, the color currently associated with Automatic displays on the button or in the drop-down list:

The **Button**



The **Drop-Down List**



Origin selects the **Automatic** color using the following scheme:

When Automatic is selected in this color control...	...This setting determines color
(Fill) Pattern Color	(Border) Color
(Drop Lines) Color	Symbol Color
Symbol Color	(Line) Color. If the data plot does not include a Line tab, then display Black.
(Symbol) Edge Color	(Line) Color. If the data plot does not include a Line tab, then display Black.
(Symbol) Fill Color	Default Symbol Fill Color drop-down list selection on the Graph tab of the Options dialog box.
(Error bar) Color	Symbol Color. If no symbol exists, (Line) Color.

Some of Origin's color buttons and color drop-down lists also include a **None** option. When you select **None**, the data plot element display is transparent.

Displaying Each Data Point in Your Plot Using the Sequence of Colors in the Color Palette

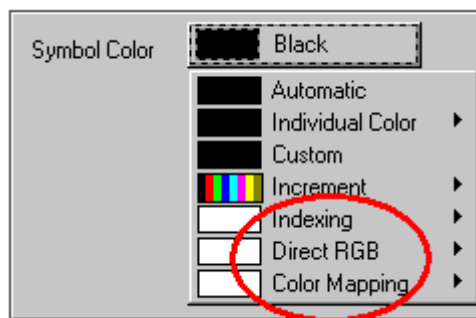
To increment the color of all data points in a data plot:

1. Click the color button and select **Increment**.
2. Choose your starting color from the associated submenu. Origin displays the selected sequence on the Increment button.
3. Click **OK** or **Apply**. Origin increments the color across data points (by index or row number) following the sequence of colors in the color palette.

Note: **Increment** is not available if the data plot is part of a data plot group and color incrementing is enabled on the **Group** tab for that particular data plot element (for example, Symbol Color for grouped Scatter plots). To make **Increment** available, select the **Edit Mode = Independent** radio button on the **Group** tab of the Plot Details dialog box.

Using Values in a Data Set to Control Data Plot Color

Origin can use the values in a column of worksheet data to set colors in a data plot. Setting color control by data set is done via a data plot element's color button (for example, the **Symbol Color** button).



Origin uses the value in a given row to set colors for data set values in the same worksheet (or Excel workbook) row. For instance, for the data point defined by XY values in row 56, Origin would set the XY

data point color by the value in row 56 of the designated "color control" data set. The color control data set must be to the *right* of the data plot data set in the worksheet.

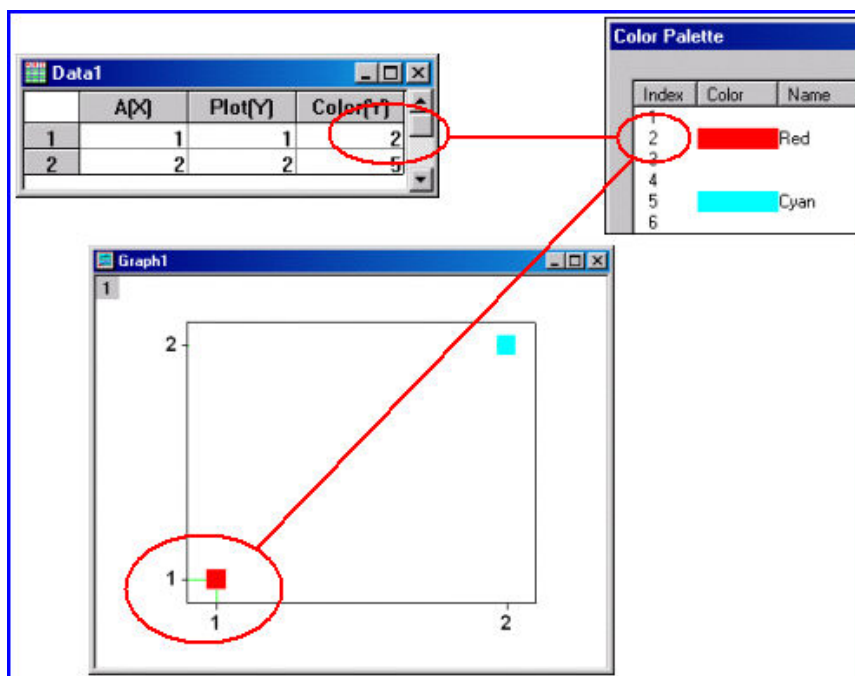
If the data plot is part of a (dependent) data plot group, Origin applies the values of the designated color control data set to the *first* data plot in the group. Simultaneously, Origin checks the worksheet column number of the first grouped data plot's Y data set, and compares this location to the worksheet column number of the "color control" data set, storing the difference, *n*. For the remaining data plots in the group, Origin looks *n* columns to the right for each grouped data plot's respective color control data set.

A color control data set can be used in one of three ways:

- Indexing

This option allows you to specify a data set whose values denote the order of colors (index number) in the Origin **Color Palette**.

For example, if the selected data set contains values **2** and **5** in rows 1 and 2 respectively. Origin displays the first data point using the *second* color (color **2**) in the Color Palette, and the second data point using the *fifth* color (color **5**) in the Color Palette.



If a color control data set value exceeds the number of colors in the color palette, Origin displays the associated data point in black.

To use this option:

1. Double-click on the data plot that you wish to modify. This opens the **Plot Details** dialog box.
2. Select the **Symbol** tab, **Pattern** tab, etc.
3. Click the **Color** button to the right side of the dialog box and select **Indexing:Dataset - Dataset** being the name of the column that stores the color control data.



- Direct RGB

An RGB composite value is computed from triplet components of **Red**, **Green**, and **Blue**. The **R**, **G**, and **B** component values range from 0 to 255.

$$\text{RGB composite} = (256^0 * \mathbf{R}) + (256^1 * \mathbf{G}) + (256^2 * \mathbf{B})$$

which is equivalent to:

$$\text{RGB composite} = \mathbf{R} + (256 * \mathbf{G}) + (65536 * \mathbf{B})$$

To use this option:

1. Double-click on the data plot that you wish to modify. This opens the **Plot Details** dialog box.
2. Select the **Symbol** tab, **Pattern** tab, etc.
3. Click the **Color** button to the right side of the dialog box and select **Direct RGB:Dataset**, where **Dataset** contains the RGB composite values.

- Color Mapping

With this option you create a mapping relationship between ranges of 2D Y values or 3D Z values and an associated scale of colors. The 2D Y values or 3D Z values are then used to determine the data point element colors in the data plot, based on the established color map.

To use this option:

1. Double-click on the data plot that you wish to modify. This opens the **Plot Details** dialog box.
2. Select the **Symbol** tab, **Pattern** tab, etc.
3. Click the **Color** button to the right side of the dialog box and select **Color Mapping:Dataset**. When the option is selected, a **Color Map/Contours** tab displays in the Plot Details dialog box.

Origin automatically creates a color scale with 8 colors (plus a color above and below), and maps the data set values to these colors by finding the maximum and minimum data set values, and an increment that results in 8 levels.

To customize this default color map:


4. Select the **Color Map/Contours** tab and assign custom Y or Z value ranges to associated colors.
5. Select **Graph:New Color Scale** (or right-click in the layer and select **New Color Scale**) to display a color scale and the associated data set mapping relationship in the graph. (The numeric format of the color scale is set on the (Plot Details) **Numeric Formats** tab.)

The color mapping option is particularly useful for presenting data in which you have two independent variables and one dependent variable. You can plot the dependent variable versus one of the independent variables, and then use the second independent variable to color map your data plot. For example, suppose you measured some response of a sample at various positions along its length, while also varying the temperature of the sample along its length.

Without using the color mapping option, you could present your results in a two layer graph, showing the variation of temperature along the sample length, as well as the measured response.

However, by using the color mapping option, you can plot the measured response of the sample versus position, and use the temperature data to color map the data plot.

To learn more about color maps, review the 3D SURFACE & CONTOUR.OPJ and the CONTOUR.OPJ projects located in your Origin \SAMPLES\GRAPHING\3D PLOTS folder. Additionally, review the COLOR SCALE.OPJ project located in your Origin \SAMPLES\GRAPHING\2D PLOTS folder.

Note: You cannot designate a color control data set that is to the left of the Y or Z data plot column in the worksheet. If necessary, move the color control data set using the **Move Right**  button on the Column toolbar.

Creating a Custom Color

In addition to selecting a color, you can create a custom color from the color button options and from some of the color drop-down lists. To create a custom color:

1. Click the color button and select **Custom**.
2. Right-click on the **Custom** button to open the **Color** dialog box.

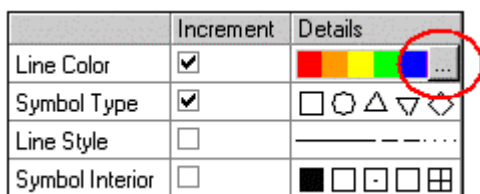
After defining a custom color, the color displays in the Custom button.


Group Incremental Color Lists

Commonly, users would like to apply a different color scheme to their grouped data plots. You can create and apply custom incremental color schemes to grouped data plots.

To create an incremental color scheme:

1. Activate your graph containing your grouped data plots and select **Format:Plot**. This opens the **Group** tab of the Plot Details dialog box.
2. Click once on the **Details** column heading. A button will appear to the right side of the color scale (**Line Color**).



3. Click once on the  button. This opens a color scheme dialog box.
4. Customize the color scheme:
 - To add a color, right-click on the list and choose **Add...**
 - To delete a color, right-click on the color and choose **Delete**.
 - To switch color schemes, right-click on the list and choose **Load...**. Choose an alternate color scheme from the shortcut menu.
 - To save a customized color scheme, right-click and choose **Save....** Name your color scheme and save it for future use.

Note that once you save a color scheme, you can recall it from the **Load...** shortcut menu command or you can load it from the (Font/Line/Border) **Color** drop-down list on the **Style** toolbar.

To apply an incremental color scheme to your graph:

1. Click on any plot in the plot group to select the entire group. Selection handles will appear on all grouped data plots.

2. Scroll to the bottom of the (Font/Line/Border) **Color** drop-down list on the **Style** toolbar and choose your incremental color list.



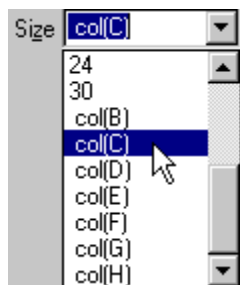
or


1. Activate your graph window and choose **Format:Plot**. This opens the **Group** tab of the Plot Details dialog box.
2. Right-click inside the properties list and choose **Load...**, selecting your incremental list from the drop-down list.

Note that other incremental schemes can be developed for other plot characteristics -- line style, symbol type, fill color, fill style, etc. To learn more, see *Group Incremental Lists* on page 358.

Using Data Sets as a Plotting Enhancement

Color is not the only plot attribute that is controllable by values in a data set (see, *Using Values in a Data Set to Control Data Plot Color* on page 316). Other data plot elements (for example, scatter plot symbol size) can be set by values from an Origin worksheet or Excel workbook data set. These plot control options are chosen from drop-down lists and combination boxes in the Plot Details dialog box. When such options are available for a specific data plot element, Origin will list Col(*Name*) entries at the bottom of the drop-down list or combination box, where *Name* is the worksheet or Excel workbook column name.



Origin only lists the active data plot's Y or Z columns in the worksheet, and columns that are located to the *right* of these columns. If you want to specify a column that is not listed (because it is located to the *left* of the data plot's Y or Z column), move the desired worksheet column with the **Move Right**  button on the Column toolbar.

Note that if you intend to implement data set control of plot elements for each plot in a (dependent) group, you will need to supply a separate column of control values for each data plot in the group. When you group data sets, Origin increments display properties among grouped data sets. Thus, Origin expects that you will specify a display control data set for the first Y column in a group that is *n* columns to the right of the Y data set. For the next data plot in the group, Origin, looks *n* columns to the right of *this* Y column to find the display control data set for that data plot, and so on. So, if your group contains 5 plots, you will need to set up your worksheet with 5 display control data sets; each control data set must be *n* columns to the right of the data set that it controls.

Origin supports data set control of the following data plot elements:

- Color

Origin provides three methods for using the values in a specified column to control the color of elements in a data plot:

- indexing
- direct RGB
- color mapping

To learn more, see Customizing the Colors in Your Data Plot

- Symbol Shape

To specify a column to control symbol shape:

1. Open the Plot Details dialog box (**Format:Plot**).
2. Choose the **Symbol** tab.
3. Select the **Show Construction** check box.
4. Select the plot control data set in the **Shape** drop-down list.

When you select a column from the **Shape** drop-down list, Origin makes the following association between numeric values and symbol shapes: 0 = no symbol, 1 = square, 2 = circle, 3 = up triangle, 4 = down triangle, 5 = diamond, 6 = cross (+), 7 = cross (x), 8 = star (*), 9 = bar (-), 10 = bar (|), 11 = *number*, 12 = *LETTER*, 13 = *letter*, 14 = right arrow, 15 = left triangle, 16 = right triangle, 17 = hexagon, 18 = sphere, 19 = star, 20 = pentagon. For any numeric values outside of this range (except 56 and 58), no symbol displays.

The numeric values of 56 and 58 display special symbol types: 56 = data markers and 58 = vertical lines that mark the X position of the data point.

If your data plots are part of a plot group, you will note that the **Shape** drop-down list does not support use of a data set to control display of plot symbol shape.

- Symbol Interior

To specify a column to control symbol interior:

1. Open the Plot Details dialog box (**Format:Plot**).
2. Choose the **Symbol** tab.
3. Select the **Show Construction** check box.
4. Select the plot control data set in the **Interior** drop-down list.

When you select a column from the **Interior** drop-down list, Origin makes the following association between numeric values and symbol interiors: 0 = no symbol, 1 = solid, 2 = open, 3 = dot center, 4 = hollow, 5 = + center, 6 = x center, 7 = - center, 8 = | center, 9 = half up, 10 = half right, 11 = half down, 12 = half left. For any numeric values outside of this range, no symbol displays.

If your data plots are part of a plot group, you will note that the **Interior** drop-down list does not support use of a data set to control display of plot symbol shape.

- Symbol Size

To specify a column to control symbol size:

1. Open the Plot Details dialog box (**Format:Plot**).
2. Choose the **Symbol** tab.
3. Select the **Show Construction** check box.
4. Select the plot control data set from the **Size** drop-down list.

When you select a column from the **Size** combination box, the data set values determine the data point size in units of points. You can scale those data set values by selecting or typing a value in the associated **Scaling Factor** combination box.

- Angle (for XYAM vector data)

To specify a column to control angle:

1. Open the Plot Details dialog box (**Format:Plot**).
2. Choose the **Vector** tab.
3. Select the plot control data set in the **Angle** drop-down list (**Vector Data** group).

When you select a column from the **Angle** drop-down list, the data set values determine the vector angle for each data point in the associated row. The units are determined by the **Angular Unit** group on the **Numeric Format** tab of the **Options** dialog box (**Tools:Options**).

- Magnitude (XYAM vector data)

To specify a column to control magnitude:

1. Open the Plot Details dialog box (**Format:Plot**).
2. Choose the **Vector** tab.
3. Select the plot control data set in the **Magnitude** combination box (**Vector Data** group).

When you select a column from the **Magnitude** drop-down list, the data set values determine the vector magnitude in units of points.

Note: The X End and Y End drop-down lists on the Vector tab of the XYXY vector Plot Details dialog box also list columns for control selection. However, the XYXY vector plot elements are only controllable by worksheet data set selection.

An Example: Setting Symbol Shape with a Data Set.

1. Create the following worksheet and then highlight column B and click the Line + Symbol button on the 2D Graphs toolbar.


A(X)	B(Y)	C(Y)
1	1	1
2	2	2
3	3	1
4	4	2
5	3	1
6	2	2
7	1	1

2. Double-click on the data plot to open the Plot Details dialog box.
3. On the Symbol tab, select the **Show Construction** check box.
4. Select **Col(C)** from the **Shape** drop-down list.
5. Click **OK**.

Displaying Both Symbol Shapes in the Legend

1. Make the worksheet active and click the Add New Columns button on the Standard toolbar. Origin adds one D(Y) column to the worksheet.
2. Make the graph active and double-click on the layer 1 icon in the upper-left corner of the graph. This action opens the Layer 1 dialog box.
3. Click on **data1_d** in the Available Data list and then click the right arrow button to move this data set into the Layer Contents list.
4. Click the Layer Properties button to open the Plot Details dialog box with the layer icon selected on the left side of the dialog box.
5. Click the plus sign next to the layer icon to view the associated data plot icons.
6. Click on the Data1: A(X), D(Y) icon on the left side of the dialog box. This data plot's controls become active on the right side of the dialog box.
7. Select Line + Symbol from the Plot Type drop-down list (on the left side of the dialog box).
8. On the Symbol tab, click the down arrow next to the Preview view box.
9. Select the filled circle (column 1, row 2).
10. Click OK twice to close both dialog boxes.
11. Double-click on the "B" in the legend to open the legend's Text Control dialog box.
12. Replace **L(1) %(1)** with the following text: **L(1)\L(2) %(1)**
13. Click OK. The legend updates displaying a square and circle data plot icon.

In this example, a line + symbol data plot is created. Subsequently, a data set is designated to control symbol shape, with symbols alternating between squares and circles.

1. Create the following worksheet and then highlight column **B(Y)** and click the **Line + Symbol**  button on the 2D Graphs toolbar.

	A[X]	B[Y]	C[Y]
1	1	1	1
2	2	2	2
3	3	3	1
4	4	4	2
5	5	3	1
6	6	2	2
7	7	1	1



- Double-click on the data plot to open the Plot Details dialog box.
- On the **Symbol** tab, select the **Show Construction** check box.
- Scroll to the bottom of the **Shape** drop-down list and select **Col(C)**.
- Click **OK**.

Note that the Line & Symbol plot now displays with two symbol shapes -- filled circle and filled square. What you have done is to use the C(Y) column values -- either **1** or **2** -- to determine symbol shape. You are probably wondering how these values relate to symbol shape. If you

To Display Both Symbol Shapes in the Legend:

In the previous example, we used values in data set to determine symbol shape for a single 2D line & symbol plot. The result was a plot where symbol type varied by data point. In such cases, the plot symbol in the legend will not accurately represent the data plot.

In the following example, an empty D(Y) column (without data) is added to the graph layer as a line + symbol data plot with circle symbols. Because the column contains no data, the data plot doesn't actually plot in the graph layer. However, we can use the data set's plot attributes to customize the legend display.

- Make the worksheet active and click the **Add New Columns**  button on the Standard toolbar. Origin adds a **D(Y)** column to the worksheet.
- Make the graph active and double-click on the layer **1** icon in the upper-left corner of the graph. This opens the **Layer 1** dialog box.
- Select the added **D(Y)** column in the **Available Data** list and click  to move this data set into the **Layer Contents** list.
- Click the **Layer Properties** button to open the Plot Details dialog box with the layer 1 icon selected on the left side of the dialog box.
- Click the plus sign next to the layer icon to view the associated data plot icons.
- Click on the **WorksheetName: A(X), D(Y)** icon on the left side of the dialog box. The controls for this data plot become active (on the right side of the dialog box).
- Select **Line + Symbol** from the **Plot Type** drop-down list (bottom-left side of the dialog box).
- On the **Symbol** tab, click the down arrow next to the **Preview** view box.
- Select the **filled circle** (column 1, row 2).
- Click **OK** twice to close both dialog boxes.
- Right-click on the **B** in the legend and select **Properties** from the shortcut menu. This opens the legend's **Text Control** dialog box.

12. Replace \L(1) %(1) with the following text: \L(1)\L(2) %(1)

13. Click **OK**. The legend now displays a square and circle data plot icon.

To learn more about customizing the legend, see *How to Have Complete Control Over the Legend Display* on page 416.

Note: To display an enhanced legend that conveys information about the data point display properties, select **Graph:Enhanced Legend**.

Data Plots: Customizing Specific Elements

Symbols

Displaying Every *n*th Data Point

To display every *n*th data point in a **line + symbol** or **scatter** data plot:

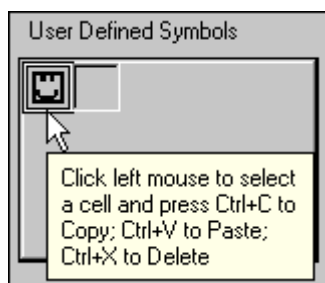
1. Double-click on the data plot to open the Plot Details dialog box.
2. Select the **Drop Lines** tab, and then select the **Skip Pts** check box in the **Data Points Display Control** group.
3. Specify the data point display frequency in the associated text box. For example, type **5** in the text box to display every 5th data point as a symbol.
4. To display a continuous line in a line + symbol data plot with "skip points" enabled, select the (Plot Details) **Line** tab and clear the **Gap to Symbol** check box in the **Symbol/Line Interface** group.

Displaying Your Bitmaps as Symbols

You can display bitmaps that you have created in other programs as symbols in your graph. The bitmaps cannot exceed 16 x 16 pixels in size. If a bitmap is larger than this, Origin will display only the upper-left corner of the bitmap.

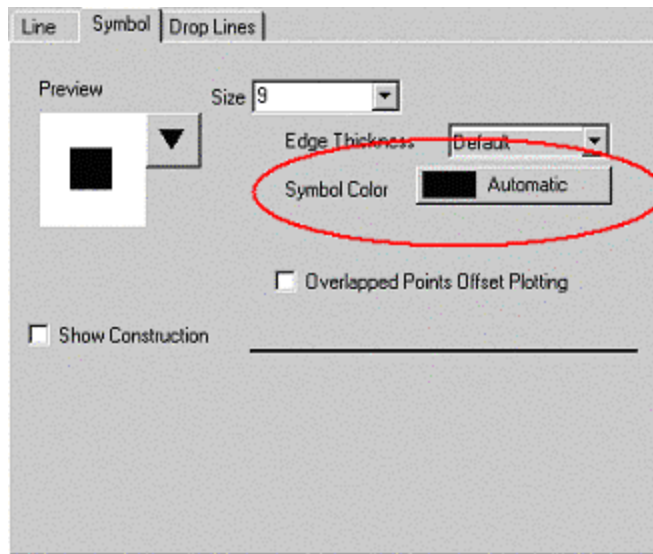
To display your bitmap as a data plot symbol, do the following:

1. Copy your bitmap to the Clipboard.
2. In Origin, select **Tools:Options** and then select the **Graph** tab.
3. Click on a cell in the **User Defined Symbols grid**. While pointing at the cell, press CTRL+V. This keyboard operation pastes the symbol from the Clipboard into the cell. To copy a symbol from a cell in the grid, click on the cell and press CTRL+C. To delete a symbol from a cell, press CTRL+X.



4. Click **OK** to close the **Options** dialog box.
5. Re-open the (Plot Details) **Symbol** tab. Your user-defined symbols display at the bottom of the symbol gallery. You can also use your symbols when the **Show Construction** check box is selected and the associated **User Defined Symbols** radio button is selected.

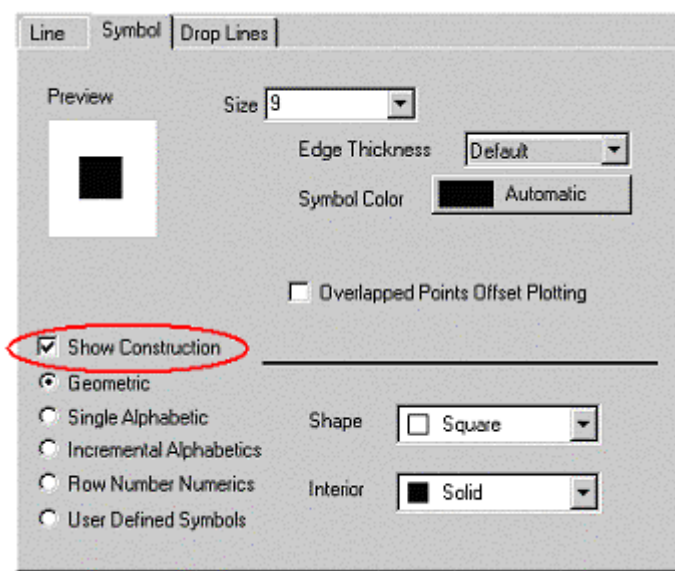
All white portions of your bitmap will display as transparent in the data plot symbol. The black portions of your bitmap, or any colored portions, will display using the color from the **Symbol Color** button.



Note: On some computers, user-defined symbols may display as black squares in regions of the graph. If you experience such display problems, try resolving the problem by increasing the setting of your Windows Color Palette. For example, if your current setting is 256 color, increase the setting to True Color (24 bit). Additionally, the user-defined symbols display problem might be resolved by updating your printer driver. To check if the printer driver is causing the display problem, restart your computer in Safe Mode. If this change resolves the display problem, then consider updating your printer driver.

Constructing Custom Symbols: Geometric Symbols, Font Set Characters, Row Numbers and User-Defined Symbols

In addition to using symbols from the Symbol Gallery you can **construct** custom symbols. To construct symbols, select the **Show Construction** check box on the (Plot Details) **Symbol** tab.



Once selected, a number of controls display beneath the check box that allow you to:

- Construct a geometric symbol.

Select **Geometric** to use a symbol from the **Shape** drop-down list and an interior pattern from the **Interior** drop-down list.



Select **Hollow** from the **Interior** drop-down list to display overlapping data plot elements through the symbol.

Select **Open** from the **Interior** drop-down list to prevent overlapping data plot elements from displaying through the symbol (except when **None** is selected from the **Fill Color** button, in which case the overlapping elements display).

- Use a character from a font set as a symbol.

Select **Single Alphabetic** to use a *single* alphanumeric character for *all* the points in the data plot. Select the desired font set and character from the associated controls.

- Select a starting character from which to increment through a font set.

Select **Incremental Alphabets** to use alphanumeric characters *incrementing by one for each consecutive data point* in the data plot. Select the desired font set and "start" character from the associated controls.

- Use row numbers as symbols.

Select **Row Number Numerics** to use the data point's row number as the symbol in the data plot. Select the desired font set from the associated drop-down list.

- Select a user-defined symbol.

Select **User Defined Symbols** to use a bitmap that you added to the **User Defined Symbols grid** on the **Graph** tab of the **Options** dialog box. Available user-defined symbols display in the **Symbol List** drop-down list.


Note: When either **Single Alphabetic** or **Incremental Alphabets** is selected, the **Outline** check box is available. Select this check box to display an outline or box around each data point symbol.

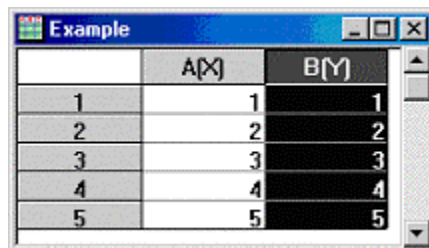
Using a Data Set to Control the Symbol Display in a Data Plot

Use the **Show Construction** controls on the **Symbol** tab to specify a worksheet column whose values determine the symbol display on a point-by-point basis. Column values are index numbers associated with the symbol list. This option is available for geometric symbols and user-defined symbols. However, it is only available when editing a data plot that is either...

- *not* part of a group.
- *is* part of a group but which has **Edit Mode** set to **Independent**.

This short tutorial illustrates how this works:

1. Create this worksheet, highlight column B(Y) and click the **Scatter** button  on the **2D Graphs** toolbar.

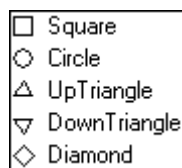


	A[X]	B[Y]
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5

This creates a scatter plot with black, filled-square symbols.

2. From the menu, select **Format:Plot**. This opens the **Symbol** tab of the **Plot Details** dialog box.
3. Select the **Show Construction** check box.
4. Select the **Geometric** radio button.
5. From the **Shape** drop-down list, select the **col(B)** (at the bottom of the list).
6. Click **OK**. The scatter plot symbols should display as square, circle, up triangle, down triangle, and diamond.

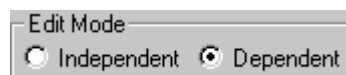
Note that symbol shape increments by data point, with the values in column B -- 1, 2, 3, 4, and 5 -- controlling symbol shape; the first five symbol shapes are nothing more than the first five symbols in the **Symbol** tab's **Shape** drop down list.



Note: The symbol control data set and the data points data set don't need to be the same data set. A separate column can supply the symbol shape specification.

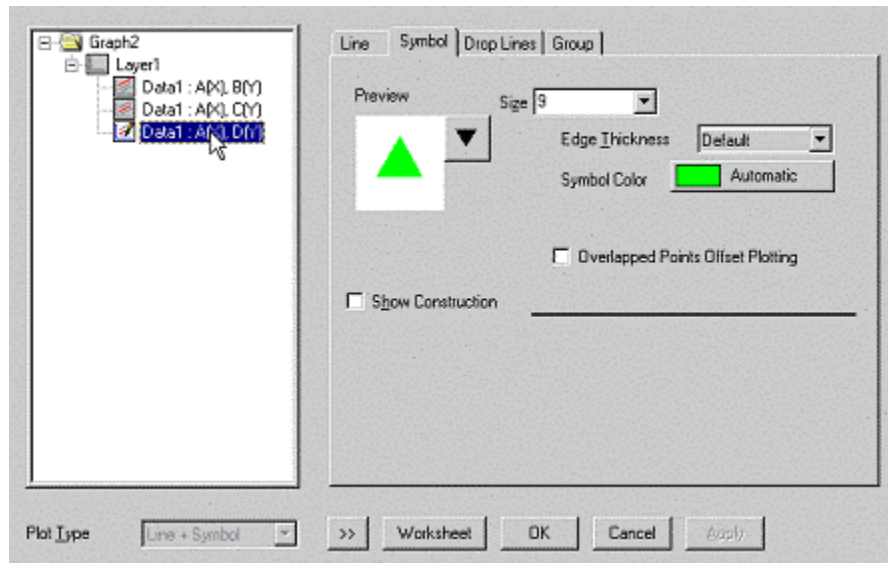
Controlling Symbols within Grouped Data Plots

The method for editing symbol shape in grouped data plots is determined by the **Edit Mode** setting on the **Group** tab of the **Plot Details** dialog box.



When Edit Mode is set to **Dependent** (default), you can best control symbol shape (or any other plot attribute) by creating and manipulating Group Incremental Lists.

When Edit Mode is set to **Independent**, you are free to edit data plot attributes independently. The plot attributes that were set at the time of grouped data plot creation are retained but there is no longer any dependency of plot attributes among grouped data sets. Note that choosing Independent will remove the Group Incremental List controls from the Group tab of the Plot Details dialog box. Hence, any editing of plot attributes should be done for each data set using the controls on the available tabs of the Plot Details dialog box, using the same methods as one would use to edit ungrouped data plots.

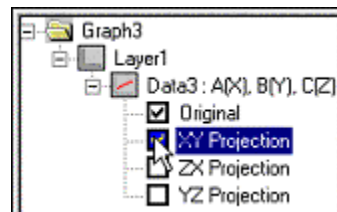


Working with Symbols in 3D Graphs

The Plot Details dialog box for 3D scatter and trajectory graphs also includes the option to display XY, ZX, and YZ projections of the (original) 3D data plot.

To project data onto the XY, ZX, or YZ plane:

1. With your 3D scatter or trajectory graph active, select **Format:Plot** from the Origin menu. This opens the Symbol tab of the Plot Details dialog box.
2. Select the check box associated with the projection icon, in the left side of the Plot Details dialog box.

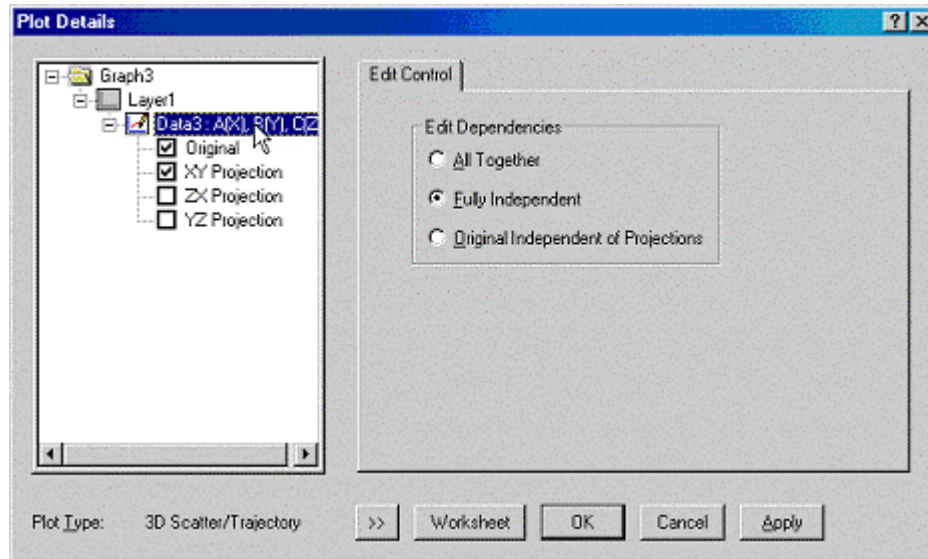


3. Click **Apply** or **OK** to project the original plot onto the selected plane.

You can control the symbol attributes of projected plots just as you can the symbol attributes of the original plot. This includes the option to select the **Show Construction** check box with all of the associated symbol construction options.

Whenever the data plot icon is selected on the left side of the dialog box, an **Edit Control** tab displays.

The Edit Control tab is provided so that you can display projections in your 3D scatter or trajectory graph, and quickly control their display based on your original 3D data plot settings. Alternatively, you can use this dialog box for custom edit control.



- Select **All Together** to display and edit the settings on the (Plot Details) **Line**, **Symbol**, and **Drop Lines** tabs for the 3D data plot (original) *and* the three projections.
- Select **Fully Independent** to edit each of the 3D data plot elements (original, XY, ZX, and YZ) separately.
- Select **Original Independent of Projections** to edit the 3D data plot (original) element separate from the projections.

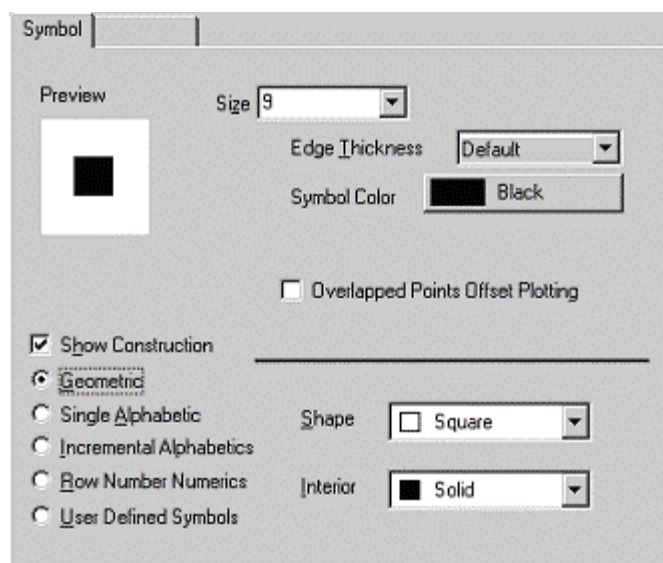
Note: When you select a data plot element icon on the left side of the dialog box, be careful not to inadvertently clear the icon's check box. To activate the tabs of a data plot element icon with a selected check box, click on the text next to the icon, not in the check box.

To learn more about 3D scatter graphs, review the 3D SCATTER.OPJ project located in your Origin \SAMPLES\GRAPHING\3D PLOTS folder.

The (Plot Details) Symbol Tab

The symbols in **2D scatter**, **line + symbol**, and **ternary** graphs; **box**, **histogram + probabilities**, and **QC** statistical charts; as well as in **3D scatter** and **trajectory** graphs are all controlled from the **(Plot Details) Symbol** tab.

Symbol Tab Controls



The Preview Group

Click the down arrow next to the **Preview** box (not shown) to open the symbol gallery for symbol selection. Display characters in the symbol gallery by selecting the **Symbol Gallery Displays Characters** check box on the **Graph** tab of the **Options** dialog box. When this option is enabled, use the **Font in Gallery** drop-down list (in the **Preview** group) to control the character list.

The Size Combination Box

Type or select the symbol size, in points, from the Size combination box. If you select a worksheet column from this combination box, a **Scaling Factor** combination box displays. Type or select a value to scale the associated column values. For example, select 0.25 to scale each cell value by 0.25.

The Edge Thickness Drop-down List

Select the desired value from this drop-down list to determine the border width of hollow or open symbols. Enter n to specify the width of the symbol border as $n\%$ of the symbol's half diameter. Select **Default** to use the value specified from the **Symbol Border Width** combination box on the **Graph** tab of the **Options** dialog box.

The Color Buttons

Depending on your symbol selection, either a **Symbol Color** button displays, or a **Symbol Edge Color** button and a **Symbol Fill Color** button display. Select a color by clicking on the respective button.

The Overlapped Points Offset Plotting Check Box

If your data includes repeated (X,Y) pairs, you can display the repeated pairs with an X offset, and then display the actual (X,Y) value as a short vertical line by selecting this check box.

The Show Construction Check Box and Associated Controls

Select **Show Construction** to build symbols for your graph, based on your selections from the associated controls.

Select **Geometric** to use a symbol from the **Shape** drop-down list and an interior pattern from the **Interior** drop-down list. Select **Hollow** from the drop-down list to display overlapping data plot elements through the symbol. Select **Open** from the **Interior** drop-down list to prevent overlapping data plot elements from displaying through the symbol (except when **None** is selected from the **Fill Color** button, in which case the overlapping elements display).

Select **Single Alphanumeric** to use the same alphanumeric character for all the points in the data plot. Select the desired font set and character from the associated controls.

Select **Incremental Alphanumerics** to use alphanumeric characters incrementing by one for each consecutive data point in the data plot. Select the desired font set and start character from the associated controls.

Select **Row Number Numerics** to use the row number corresponding to the data point as the symbol in the data plot. Select the desired font set from the associated drop-down list.

Select **User Defined Symbols** to display a bitmap that you added to the **User Defined Symbols grid** on the **Graph** tab of the **Options** dialog box. Your available user-defined symbols display in the **Symbol List** drop-down list.

When either **Single Alphanumeric** or **Incremental Alphanumerics** is selected, the **Outline** check box is available. Select this check box to display an outline or box around each data point symbol.

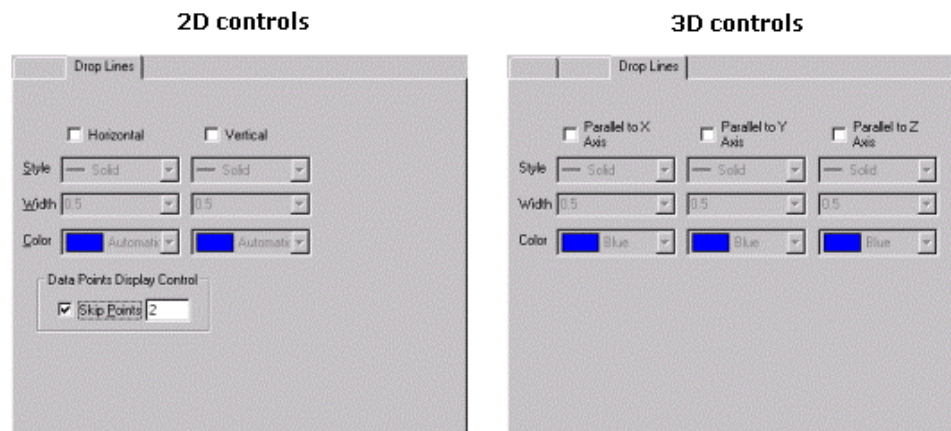
The (Plot Details) Drop Lines Tab

You can add horizontal or vertical drop lines to...

- ... any 2D data plot type that includes symbols.
- ... the Z axis for 3D scatter and trajectory graphs.

The drop lines controls are on the (Plot Details) **Drop Lines** tab.

Drop Lines Tab Controls



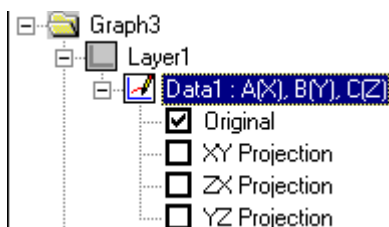
For 2D graphs: Select the Horizontal or Vertical check boxes to display horizontal or vertical lines from each data point symbol to the bottom X or left Y axis. Optionally, select the Skip Points check box in the Data Points Display Control group to display a specified frequency of data points. Type the frequency in the associated text box. For example, type 5 in the text box to display *every 5th data point* as a symbol. This setting also effects the display of the data plot drop lines, symbols, error bars, and data labels.

For 3D graphs: Select the Parallel to X/Y/Z Axis check boxes.) Select the desired line style, width, and color from the associated controls. When you select Automatic from the Color drop-down lists, Origin uses the color selected from the Symbol Color or the Edge Color buttons on the (Plot Details) Symbol tab.

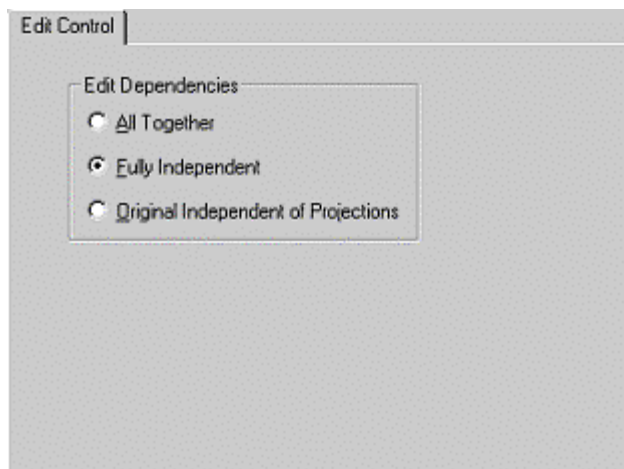
The (Plot Details) Edit Control Tab

The **Edit Control** tab is provided so that you can quickly display projections in your 3D scatter or trajectory graph, and quickly control their display based on your original 3D data plot settings. Alternatively, you can use this dialog box for custom edit control.

To see this tab, highlight the XYZ data set in the left side of the Plot Details dialog box. The Edit Control tab will appear to the right side.



Edit Control Tab Controls



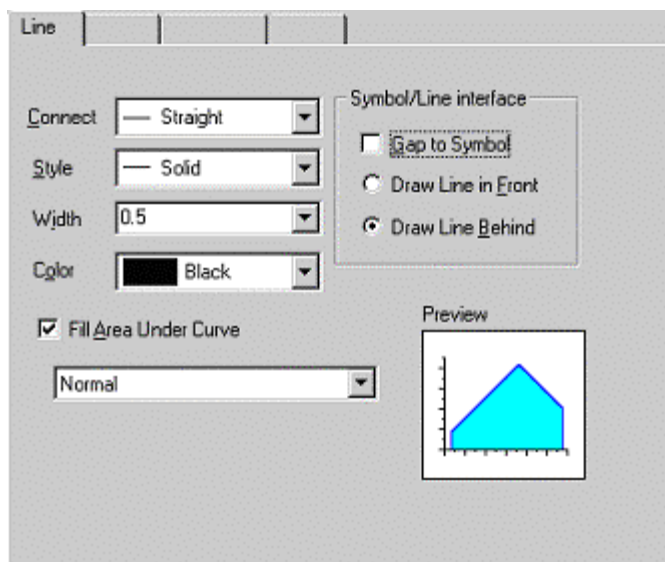
- Select the **All Together** radio button to display and edit and apply the settings on the (Plot Details) Line, Symbol, and Drop Lines tabs to the **(Original)** 3D data plot *and* to the three **Projections**.
- Select the **Fully Independent** radio button to edit elements for each of the 3D data plots (Original + three Projections) separately.
- Select the **Original Independent of Projections** radio button to edit the 3D data plot (Original) element separately from the projections.

Lines

The (Plot Details) Line Tab

The actual suite of controls available on the **Line** tab is plot-type dependent. This reference topic reviews *all* of the possible controls on this tab.

Line Tab Controls



The Symbol/Line Interface Group

Select the **Gap to Symbol** check box to display a gap between each symbol and associated line for data plots that include both lines and symbols. To alter the size of this gap, edit the Line Symbol Gap (%) combination box on the Graph tab of the Options dialog box (**Tools:Options**).

When the Gap to Symbol check box is cleared, the Draw Line in Front and Draw Line Behind radio buttons are available, allowing you to control the display of the line through the symbol. To display the line through the symbol, select the Draw Line in Front radio button. Alternatively, select the Draw Line Behind radio button to hide the line.

Note: The Draw Line in Front and Draw Line Behind radio buttons have the same visual effect on a data plot with a symbol interior set to hollow. The lines always display through the symbol. To hide the lines, select a new symbol from the symbol gallery or from the Interior drop-down list (Show Construction selected) on the (Plot Details) Symbol tab.

The Connect Drop-down List

Select the desired line connection from this drop-down list. Note that if you perform an interpolation on your data plot, the line connection type will affect the interpolation results.

The available line connection types are as follows:

- No Line

The data points are not connected.

- Straight

A straight line is displayed between data points.

- Segment

The connection display alternates between **Straight** and **No Line**.

- Segment 3

The connection display alternates between **Straight** for three points, **No Line**, **Straight** for three points, etc.

- B-Spline

For a pair of data sets with coordinates $(X[i], Y[i])$, $i = 1, 2, \dots, n$, Origin makes a smooth curve using a cubic B-spline connection. The B-spline curve can be described by parametric equations. Around point $(X[i], Y[i])$ it takes the form:

$$X_i(t) = \frac{1}{6} \{ (-t^3 + 3t^2 - 3t + 1)X[i-1] + (3t^3 - 6t^2 + 4)X[i] + (-3t^3 + 3t^2 + 3t + 1)X[i+1] + t^3X[i+2] \}$$

and

$$Y_i(t) = \frac{1}{6} \{ (-t^3 + 3t^2 - 3t + 1)Y[i-1] + (3t^3 - 6t^2 + 4)Y[i] + (-3t^3 + 3t^2 + 3t + 1)Y[i+1] + t^3Y[i+2] \}$$

where $2 \leq i \leq n-2$. The coordinates are calculated around each point letting t range from 0 to 1. This cubic B-spline curve is continuous up to a second order derivative. Unlike spline curves which pass through the original data points $(X[i], Y[i])$, the B-spline curve winds around the original data points without passing through them. (Origin duplicates the first and last data points so the curve passes through them.)

Note: One advantage of the B-spline connection is that it does not have any requirements for the original data points, whereas the spline connection requires that the X coordinates be strictly increasing.

- Spline

This option generates a cubic spline connection. To use the connection, the X values must be discrete and increasing. Furthermore, the number of data points cannot exceed 900 (if the data set exceeds this number, the operation will fail).

Since curvature information is held in memory, the spline resolution remains the same regardless of page magnification. The SplineStep variable in the ORIGIN.INI file controls the spline calculation increment. It is expressed in units of .1 point.

- Step Horz

This option generates a right angle connection. The initial line is horizontal.

- Step Vert

This option generates a right angle connection. The initial line is vertical.

- Step H Center

This option generates a right angle connection. Each point is in the middle of the horizontal run.

- Step V Center

This option generates a right angle connection. Each point is in the middle of the vertical run.

- Bezier

This option generates a Bezier curve. The Bezier curve is very similar to the B-spline curve. It can be described by parametric equations around four original data points:

$$X(t) = (-t^3 + 3t^2 - 3t + 1)X[1] + (3t^3 - 6t^2 + 3t)X[2] + (-3t^3 + 3t^2)X[3] + t^3 X[4]$$

$$Y(t) = (-t^3 + 3t^2 - 3t + 1)Y[1] + (3t^3 - 6t^2 + 3t)Y[2] + (-3t^3 + 3t^2)Y[3] + t^3 Y[4]$$

Origin uses four consecutive data points, say $(X[i], Y[i])$, $i = 1, 2, 3, 4$, to construct a section of Bezier curve letting t range from 0 to 1. The curve always passes through the first and the fourth points, but not the second and third. The next section of the curve is constructed by $(X[i], Y[i])$, $i = 4, 5, 6, 7$. The process is repeated until all data points are included (if the total number of points is not a multiple of 4, the remaining points are not used in the connection). The derivatives of the curve are not continuous over the whole range, but within each section (where t ranges from 0 to 1) the curve is continuous up to the second order derivative.

The Style Drop-down List

Select the style for the connection line from this drop-down list. At low screen resolutions or in small windows, the dashed lines may appear solid. However, a printout should draw the line correctly.

Note: You can customize the dash patterns in the **Origin Dash Lines** group on the **Graph** tab of the Options dialog box (**Tools:Options**).

The Width Combination Box

Type or select the desired line width from this combination box. The line width is measured in point size where 1 point=1/72 inch.

The Color Drop-down List

Select the desired line color from this drop-down list.

Note: You can display the lines and symbols in a line + symbol data plot using different colors. To do this, select the desired symbol color from the Symbol Color button or from the Edge Color and Fill Color buttons on the Symbol tab, and then select the desired line color from the Color drop-down list on the Line tab. Alternatively, if you edit the line Color drop-down list *first* and then click OK or Apply, both the lines and symbols in the data plot will reflect your change. This is because by default, Automatic is selected from the symbol color buttons, so that the symbol

color follows the line color. To alter this behavior, make a different selection from the symbol color buttons.

The Fill Area Under Curve Check Box and Drop-down List

- To fill the area denoted by the data plot line and the bottom X axis (assuming the axis position is not offset) for a line and a line + symbol data plot:
 1. Select **Fill Area Under Curve** and then select **Normal** from the associated drop-down list.

For the polar data plot, Origin fills the area denoted by the data plot line and the bottom X axis major grid lines at 0 and 180 degrees.
- To fill the area determined by the data plot and a baseline defined by the first and last data points in the data plot.
 1. Select **Fill Area Under Curve** and then select **Inclusive Broken by Missing Values** from the associated drop-down list .

If the data plot includes missing values, Origin fills the first segment of the data plot (up to the first missing value), and then fills the second segment of the data plot up the next missing value, etc. This option is also ideal if you want to fill an enclosed area determined by a data plot.
- To fill the region *outside of* the area determined by the data plot and a baseline defined by the first and last data points in the data plot:
 1. Select **Fill Area Under Curve** and then select **Exclusive Broken by Missing Values** from the associated drop-down list

If the data plot includes missing values, Origin fills the area outside of the first segment of the data plot (up to the first missing value), and then fills the area outside of the second segment of the data plot up the next missing value, etc. This option is also ideal if you want to fill the region outside of an enclosed area determined by a data plot.

When you select the Fill Area Under Curve check box, Origin displays a Pattern tab in the Plot Details dialog box. Edit the Pattern tab to customize the fill region.

For information on the Pattern tab, see *The (Plot Details) Pattern (or XY/YZ/XZ Faces) Tab* on page 338.

Fill Patterns

Origin provides a broad range of fill patterns for use in 2D bar, column, stack bar, stack column, floating column, floating bar, pie, area, fill area, and polar graphs; box, histogram, stacked histograms, and histogram and probabilities statistical charts; as well as in (XYY...) 3D bars, ribbons, walls, and waterfall graphs.

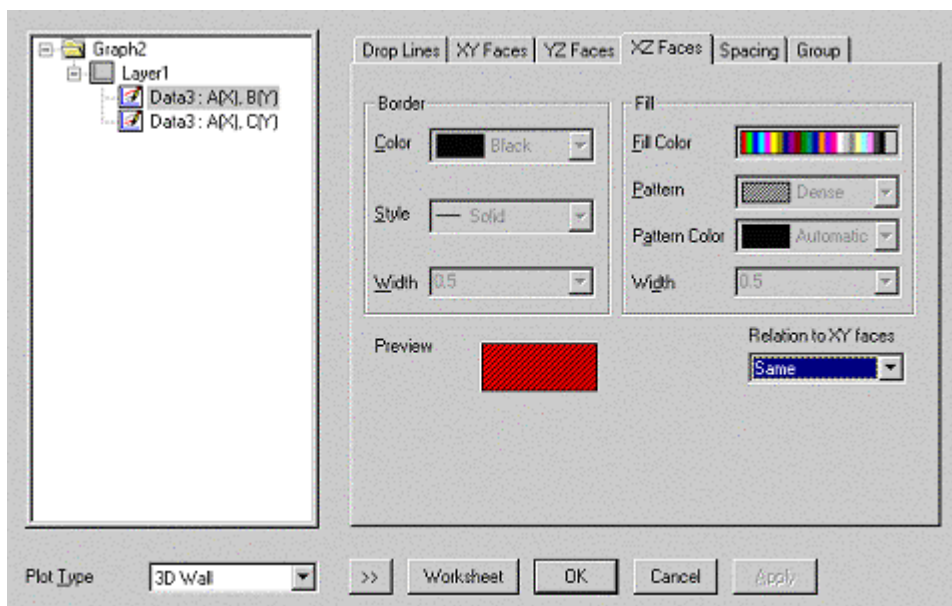
Fill pattern control is available from the (Plot Details) **Pattern** tab.

For 3D bars, walls, and waterfall graphs, this control is available from the **XY Faces**, **YZ Faces**, and **XZ Faces** tabs.

The (Plot Details) Pattern (or XY/YZ/XZ Faces) Tab

These tabs provide controls to edit the **fill region** and **border** in your graph. If a control is not appropriate for a particular graph type, the control is unavailable on the tab.

Pattern Tab Controls



The **Border** Group

- Select a border color from the **Color** button.
- Select a line style from the **Style** drop-down list.
- Select or type a line width from the **Width** combination box. The line width is measured in point size where 1 point=1/72 inch.

Note: You can customize the dash patterns available from the **Style** drop-down list in the **Origin Dash Lines** group on the **Graph** tab of the **Options** dialog box (**Tools:Options**).

The **Fill** Group

- Select the desired fill color from the **Fill Color** button. Select **None** to display a transparent fill.
- Select the desired fill pattern from the **Pattern** drop-down list.
- When a pattern is selected from the Pattern drop-down list, the **Pattern Color** button is available. Select a color from this button. When **Automatic** is selected, Origin uses the **Border Color** button setting for the pattern color.
- Type or select the desired fill pattern line width from the **Width** combination box. The line width is measured in point size where 1 point=1/72 inch.

The **Preview** Box

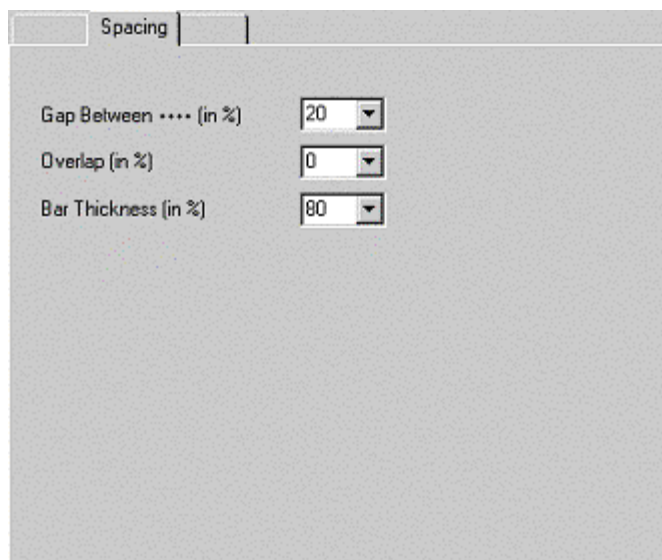
Origin displays your current tab settings in this view box.

The Relation to XY Faces Drop-down List (YZ and XZ Faces tabs only)

- Select **Same** to use the **Fill** settings on the **XY Faces** tab for the **YZ** faces (or **XZ** faces) of your 3D data plot.
- Select **Independent** to control the fill display of the **YZ** faces (or **XZ** faces) independent of the **Fill** settings on the **XY Faces** tab.
- Select **Lighter** or **Darker** to display a lighter or darker shade of the fill color selected on the **XY Faces** tab for the **YZ** faces (or **XZ** faces).

Column, Bar, and Box Spacing**The (Plot Details) Spacing Tab**

The controls on the **Spacing** tab are dependent on the current data plot type. The following reference section reviews all the possible controls on this tab.

Spacing Tab ControlsThe **Gap Between...** Combination Box

This combination box value controls the spacing between the columns, bars, or boxes *for each X value*, in units of % of the width of the columns, bars, or boxes at each X value.

The **Overlap** Combination Box

This combination box is only available if the data plot is part of a data plot group.

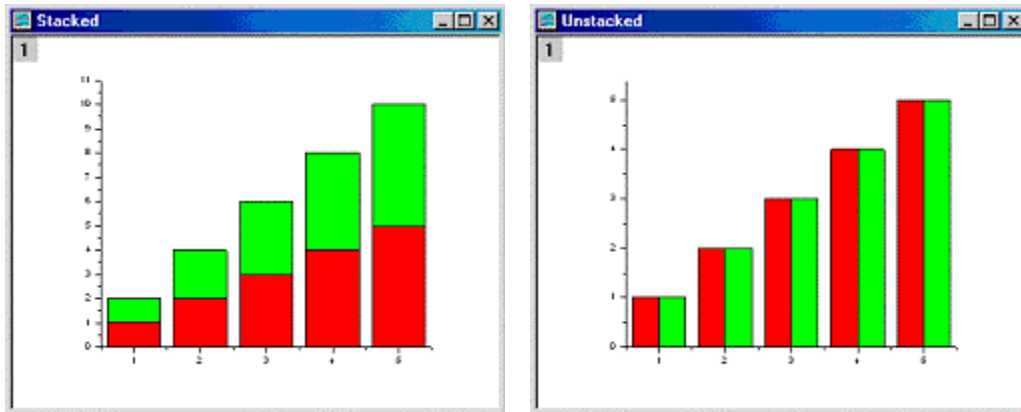
Type or select a value from this combination box to overlap the columns or bars at each X value by this amount. The combination box is in units of % of the width of an individual column or bar.

The **Bar Thickness** Combination Box

This combination box is only available for (XYY...) 3D bar graphs.

Type or select a value from this combination box to set the thickness of the 3D bars. The combination box is in units of % of the X axis increment.

Stacking Columns or Bars



To stack grouped bars or columns in the active graph layer:

1. Select **Plot:Stack Grouped Data in Layer**.

This menu command is checked when selected. Though any graph type can be stacked, this menu command is used mainly with column, bar, and area graphs.

To *unstack* the data plots:

1. Re-select **Plot:Stack Grouped Data in Layer** (to remove the check mark next to the menu command).

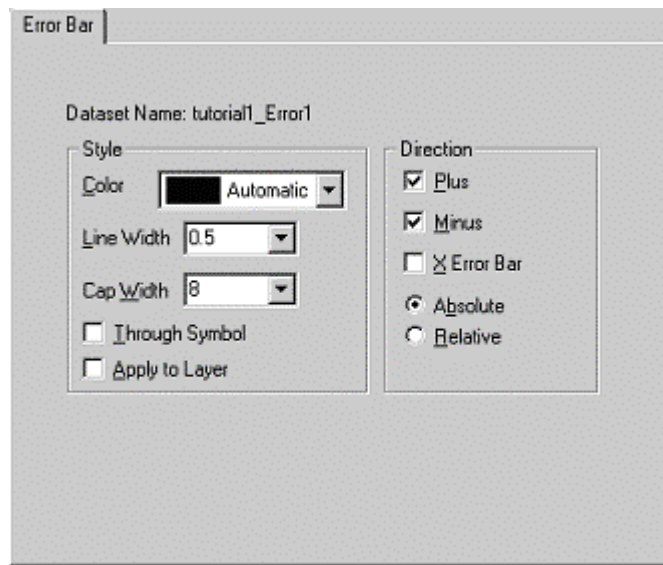
A stacked data plot displays data against a cumulative Y axis scale, with the Y values in each X axis category combined and displayed as subgroups.

Error Bars and Data Labels

The (Plot Details) Error Bar Tab

The **Error Bar** tab provides controls to edit the color, line width, and other style properties of the error bars in the data plot, as well as the direction of the error bars.

Error Bar Tab Controls



The Style Group

Color. Select the desired error bar color from the **Color** drop-down list. Select **Automatic** to ensure that the error bar color follows the associated symbol color in a data plot with symbols, or the associated line color if no symbols exist.

Line Width. Type or select the error bar line width from the Line Width combination box. The width is in units of points.

Cap Width. Type or select the error bar cap width from the Cap Width combination box. The error bar cap width is in units of points.

Through Symbol. Select the Through Symbol check box to display error bars through points in the data plot.

Apply to Layer. Select the Apply to Layer check box to apply the **Style** group settings to *all* error bars plotted in the layer.

The Direction Group

Plus. Select the Plus check box to draw error bars above the data plot, or pointing away from 0, when the **Relative** radio button is selected. This option is most useful when editing error bars in a column graph that includes negative column values.

Minus. Select the Minus check box to draw error bars below the data plot, or pointing toward 0, when the **Relative** radio button is selected.

X Error Bar. Select the X Error Bar check box to draw error bars in the X (horizontal) direction.

Absolute/Relative.

- Select the **Absolute** radio button to draw plus Y error bars pointing up and minus Y error bars pointing down.
- Select the **Relative** radio button to draw plus Y error bars pointing away from 0 and minus Y error bars pointing toward 0.

The (Plot Details) Label Tab

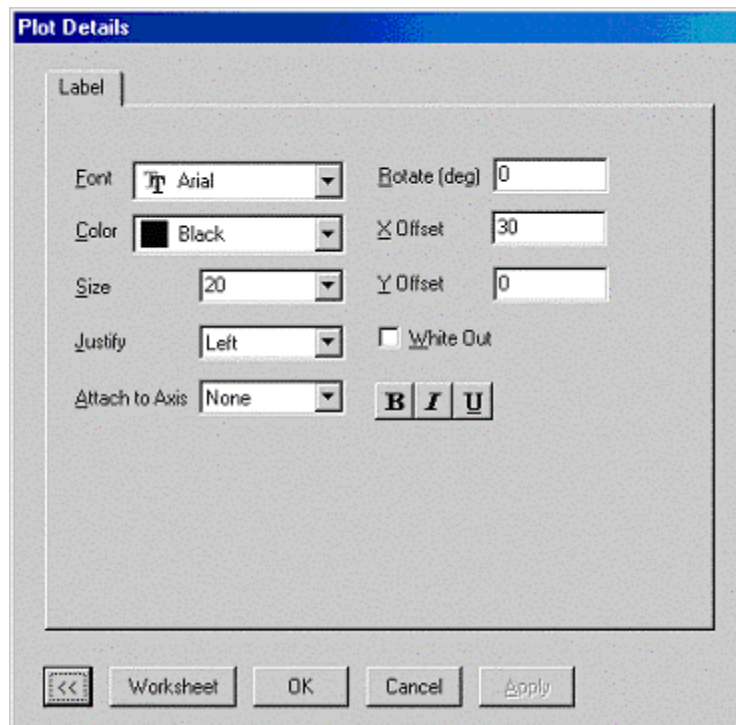
The Label tab provides controls to edit:

- The format and location of the data labels in the data plot.
- The display of contour labels in a contour graph.

The controls available on the Label tab are dependent on the type of data plot element you are editing.

The Label Tab Controls

The Label tab for scatter plot labels



The Font Drop-down List

Select a font from this drop-down list. The Default font is controlled from the **Default** drop-down list on the **Text Fonts** tab of the **Options** dialog box.

The Color Drop-down List

Select a text label color.

The Size Combination Box

Type or select a size from this combination box. The size is in units of points.

The Justify Drop-down List

You can center, left justify, or right justify the data labels relative to their associated data points. For example, select **Left** to align the left edge of the labels with the XY coordinates of the data point (**Hint:** You may want to use this setting in conjunction with the **X** and **Y Offset**).

The **Attach to Axis** Drop-down List

Align the data labels by selecting **Left Y**, **Right Y**, **Top X**, or **Bottom X** from this drop-down list. The label maintains the orientation set in the **Rotate** text box, but shifts to the specified axis location. Select **None** to align the data labels at the XY coordinate.

The **Rotate** Text Box

The value in the **Rotate** text box determines the degree of rotation of the data labels:

- Positive values rotate counterclockwise.
- Negative values rotate clockwise.

The **X Offset** and **Y Offset** Text Boxes

The **X Offset** text box determines the horizontal offset of the data labels.

The **Y Offset** text box determines the vertical offset.

The offset is measured as a percentage of the font height.

The **White Out** Check Box

Select this check box to display a white background for each data label value.

Pie Slices***Retaining the Changes You Make to the Pie Slice Labels***

Default labels display next to each slice in a pie chart. The default label display is determined by the settings on the (Plot Details) **Labels** tab.

If you customize the display of the pie slice labels as, for instance, by clicking-and-dragging to reposition a label or by double-clicking on a label to edit the text, you will need to clear two check boxes *before* printing or refreshing the graph; otherwise your customizations will be lost.

- Clear the **Associate with Wedge** check box in the **Position** group to prevent Origin from moving the labels back to their default position.
- Clear the **Automatic** check box in the **Format** group to prevent Origin from changing the content back to the default setting.

Removing the Boundary Box Around the Pie Chart

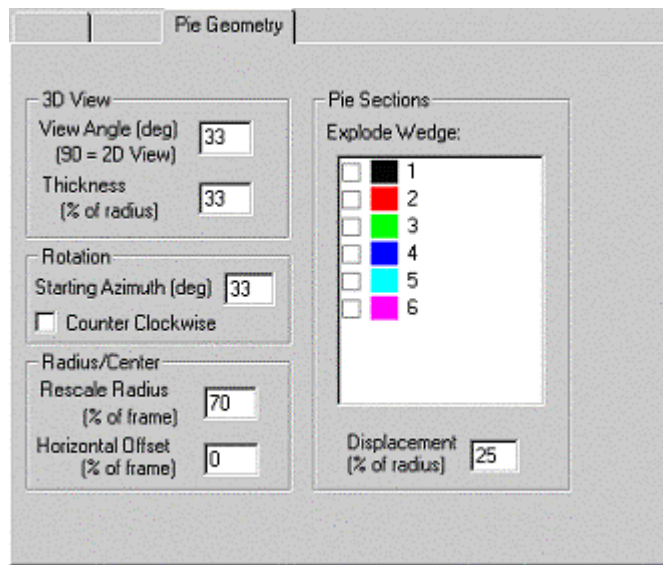
To remove the boundary box around the pie chart:

1. Select **Format:Layer** when the pie chart graph window is active.
2. Select the **Display** tab and clear the **X Axes** and the **Y Axes** check boxes in the **Show Elements** group.
3. Click **OK** to close the dialog box and remove the boundary box.

The (Plot Details) Pie Geometry Tab

The (Plot Details) **Pie Geometry** tab provides controls to edit the view and rotation of the pie chart, as well as the displacement of individual pie slices.

Pie Geometry Tab Controls



The 3D View Group

The **View Angle** text box determines the view angle of the pie chart. The units are in degrees. Type **90** to view the chart as 2D.

The **Thickness** text box determines the thickness of the pie slices. The units are in % of the pie chart radius.

The Rotation Group

The **Starting Azimuth (deg)** text box determines the location of the first pie slice in the chart.

Select the **Counter Clockwise** check box to display the pie slices in a counterclockwise orientation.

The Radius/Center Group

The **Rescale Radius** text box resizes the pie chart. The units are in % of the frame. The frame is the boundary box around the pie chart.

Use the **Horizontal Offset** text box to shift the chart to the right ($n > 0$) or left ($n < 0$). The units are in % of the frame (the boundary box around the pie chart).

The Pie Sections Group

To displace a pie slice from the pie chart, select the pie slice's check box in this group. Specify the displacement for any selected slices from the **Displacement** text box. The units are in % of the pie chart radius.

The (Plot Details) Labels Tab

The (Plot Details) Labels tab provides controls for customizing the labels of the pie chart.

Labels Tab Controls

The screenshot shows a dialog box with a 'Labels' tab. It contains two main sections: 'Format' and 'Position'. In the 'Format' section, the 'Automatic' checkbox is checked, and below it are three unchecked checkboxes: 'Values', 'Percentages', and 'Categories'. In the 'Position' section, the 'Associate with Wedge' checkbox is checked, and below it is a text box labeled 'Dist. from Pie Edge' with the value '25' entered.

The Contents Group

When the **Automatic** check box is selected, the contents of the pie slice labels are determined by the selections from the associated check boxes (see note below).

- Select the **Values** check box to display the worksheet cell values as labels.
- Select the **Percentages** check box to display the percent of the total for each cell value.
- Select the **Categories** check box to display associated X values for each pie slice. If there is no associated X column, then row numbers display.

The Position Group

When the **Associate with Wedge** check box is selected, the position of the pie slice labels are determined by the **Dist. from Pie Edge** text box. The units of this text box are in % of the pie chart radius.

Note: If you edit the label content (either via in-place methods or using the Text Control dialog box) or you move the label from its default location, *Clear* the **Automatic** and **Associate with Wedge** check boxes before making your changes. This will ensure that your changes are retained when the graph is printed or refreshed.

Vectors

Using Color to Represent the Vector Magnitude

Vector length in XYAM vector graphs is controlled by the values in the magnitude worksheet column (in units of points). Another option for displaying each vector's magnitude is to use color. You can establish a mapping relationship between ranges of magnitude values and an associated scale of colors. You can then use the worksheet magnitude values to determine each vector color in the graph, based on your established color map. The basic steps you should follow to use color to represent the vector magnitude follow.

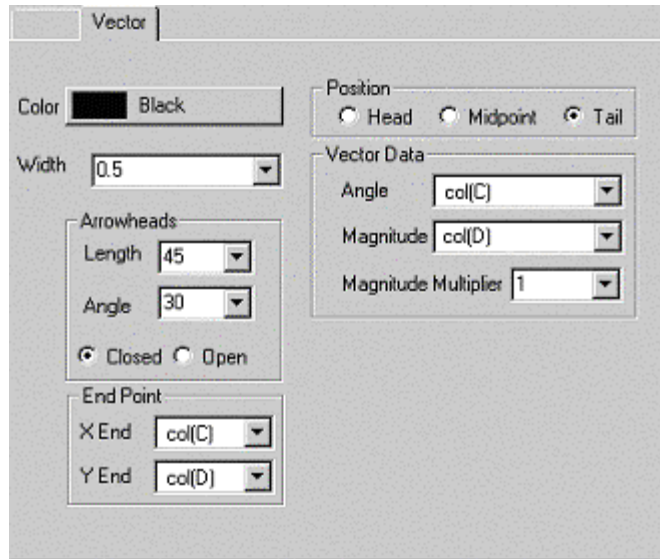
1. On the (Plot Details) **Vector** tab, select **Color Mapping:Col(MagnitudeColumn)**.
2. Set the vector length to a constant value or keep the length mapped to the *MagnitudeColumn* from the **Magnitude** combination box.

3. Select the **Color Map** tab and customize the magnitude ranges and associated colors.
4. After you close the Plot Details dialog box, add a color scale legend to your graph by selecting **Graph:New Color Scale**. Alternatively, right-click in the layer and select **New Color Scale**.

The (Plot Details) Vector Tab

The vectors in both XYAM and YXXY graphs are customized on the (Plot Details) **Vector** tab.

Vector Tab Controls



The **Color** Button

Select a vector color from the **Color** button.

The **Width** Combination Box

Type or select the desired vector width from this combination box, in units of points.

The **Arrowheads** Group

The **Length** combination box determines the length of the arrowheads. The units are in points.

The **Angle** combination box determines the arrowhead angles in degrees.

Select the **Closed** radio button to display the arrowheads with fill. Select the **Open** radio button to display the arrowheads without fill (transparent).

The **Position** Group (XYAM only)

The XY values can determine the head, midpoint, or tail of the vector. Select the desired radio button.

The **Vector** Data Group (XYAM only)

Select the column that contains the vector angle values from the **Angle** combination box. Alternatively, select a value from this combination box. The angle is measured counterclockwise from a line parallel to the X axis, bisecting the vector. The units are controlled by the **Angular Unit** setting on the **Numeric Format** tab of the **Options** dialog box (**Tools:Options**).

Select the column that contains the vector magnitude values from the **Magnitude** combination box. Alternatively, select a value from this combination box. The units are points.

Select or type a value to proportionally increase or decrease the length of the vectors from the **Magnitude Multiplier** combination box. For example, type **.5** to draw the vectors at half their original length. The default value is 1, so that the Magnitude combination box value determines the vector lengths.

The End Point Group (XYXY only)

Select the column that contains the X end point values from the **X End** drop-down list. Select the column that contains the Y end point values from the **Y End** drop-down list.

Contours

The (Plot Details) Color Map/Contours Tab

The (Plot Details) **Color Map/Contours** tab provides controls for customizing the contour levels, fill, contour lines, and contour labels for contour graphs.

In addition to contour graphs, this tab is also available when you select **Color Mapping:Col(ColumnName)** from a data plot element's **Color** button on the respective tab of the Plot Detail's dialog box.

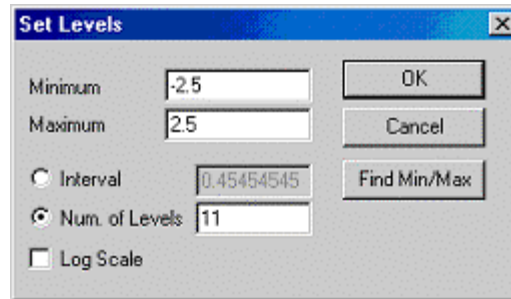
Hint: To resize a column in the dialog box view box, point the mouse at the edge of a column button until the pointer displays as a left/right arrow. Drag to resize the column.

Customizing the Contour or Color Map Levels

Origin displays a default set of Z or Y levels by finding the minimum and maximum Z or Y values plotted in the contour (or other) graph, and then finding a Z or Y increment that results in eight levels. Two additional levels are added to represent values less than, or in excess of, the minimum and maximum Z or Y values. Thus, by default there are a total of 10 levels. The fill color, lines, and labels associated with each level display to the right in the viewing box.

Level	Fill	Line	Labels
-1.1			<input type="checkbox"/>
-0.68			<input type="checkbox"/>
-0.23			<input type="checkbox"/>
0.23			<input type="checkbox"/>
0.68			<input type="checkbox"/>
1.1			<input checked="" type="checkbox"/>
1.6			<input type="checkbox"/>

- To insert a level, highlight the level that is directly below where you want the level added. Click the **Insert** button in the **Level** group to add a level. Origin divides the range for the level you clicked on in half, and assigns the first half of the range to the inserted level.
- To delete a level, click on the level to select it and then click the **Delete** button in the **Level** group. When you delete a level, the surrounding levels are not altered.
- You can edit an individual level value by double-clicking on the value and typing the desired value. You can also edit the full range of levels by clicking on the **Level** button. This action opens the Set Levels dialog box.



To customize the minimum or maximum Z or Y level, type the desired value in the associated text box. Click the **Find Min/Max** button to automatically set the **Minimum** and **Maximum** text box values, based on your Z or Y values.

Additionally, you can customize the range associated with each level or you can specify the number of levels by selecting the appropriate radio button.

If your data is plotted on a logarithmic scale, select the **Log Scale** check box to establish a logarithmic set of level ranges.

Customizing the Contour or Color Map Fill Colors and Patterns

Once you have set up the ranges of Z or Y values (levels), you can customize the color and fill associated with each level. For contour graphs, this option is only available if the **Enabled** check box is selected in the **Color Fill Control** group. When this check box is selected, you can display the fills using the contour lines as a boundary, or using the axis grid lines.

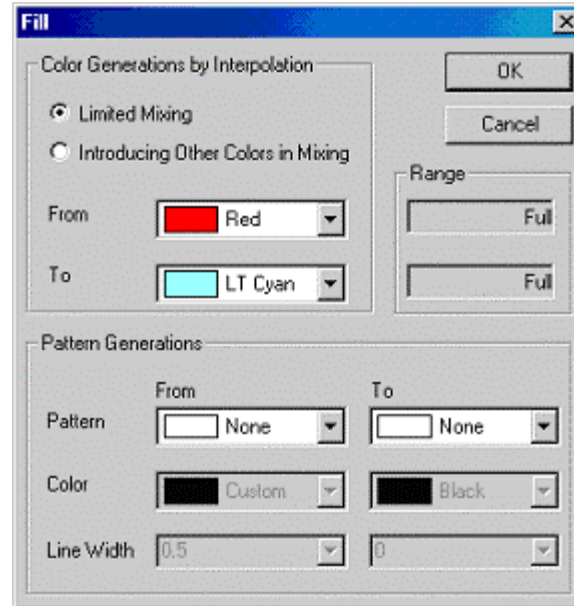


You can customize the fill associated with any level by clicking on the respective fill in the viewing box. This action opens the **Fill** dialog box for that level. Select a fill color, pattern, pattern color, and pattern line width from this dialog box. The pattern line width is in units of points. Select **None** from the **Fill Color** drop-down list for a transparent fill. To create a custom color, select **Custom** from the drop-down list and then right-click on the "Custom" text.

You can also customize a range of fills, or all the fills, by establishing the minimum and maximum fill criteria for the associated range.

To customize the fills for a range, select the desired range from the **Level** column (so that your range is highlighted), and then click the **Fill** button.

To customize all the fills, click the **Fill** button when either no level is highlighted, only one level is highlighted, or when all the levels are highlighted. These actions open the (expanded) Fill dialog box.



To customize the colors in the selected range (or for all levels), edit the controls in the **Color Generations by Interpolation** group.

Select the **Limited Mixing** radio button to select a minimum level fill color (From) and a maximum level fill color (To) and to fill the levels between these extremes with a linear mix of the two colors.

Select the **Introducing Other Colors in Mixing** radio button to have Origin automatically introduce complementary colors into the mix. This option provides fill colors that are more distinct than the Limited Mixing option.

To customize the patterns in the selected range (or for all levels), edit the controls in the **Pattern Generations** group. Select the **From** and **To** patterns, pattern colors, and line widths.

If the pattern selections are of the same style (for example, Dense to Sparse), then the pattern is interpolated between the levels.

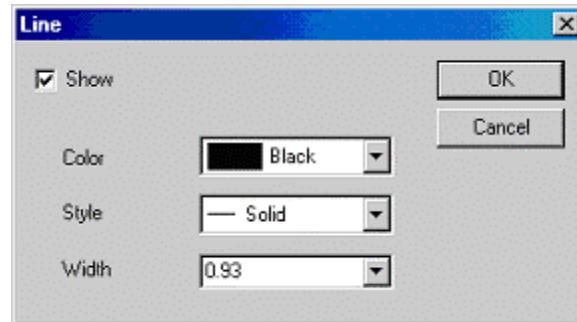
If the pattern selections are not of the same style, then the levels are split in half with the bottom half using the **From** style and the top half using the **To** style. If only one pattern is defined (for example, the From pattern), then that pattern is used for all levels.

The **Range** group displays the range of levels that are affected by the current dialog box settings. To alter the range, you must close the dialog box and select the desired range from the **Level** column of the **Color Map/Contours** tab and then click the Fill button again.

If you want to edit all the levels, make sure that no more than one level is selected from the **Level** column (or that all the levels are selected).

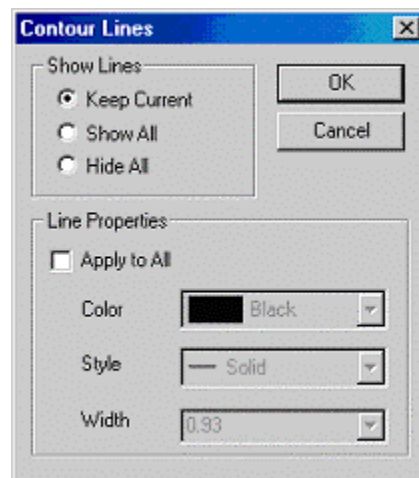
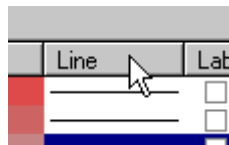
Customizing the Contour Lines

To edit the details of a contour line, click on the desired line in the viewing box. This action opens the **Line** dialog box.



Select or clear the **Show** check box to display or hide the respective line in the contour graph. When the check box is selected, you can customize the line color, style, and width from the associated controls.

To edit *all* the contour lines in your graph, click the **Line** button (on the Color Map/Contours tab). This action opens the Contour Lines dialog box.

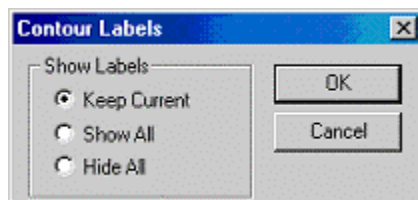


The **Show Lines** group controls the show/hide display of the contour lines. Select the **Keep Current** radio button to maintain your selections from the Color Map/Contours tab. Alternatively, select the **Show All** or **Hide All** radio buttons to show or hide all the contour lines.

The **Line Properties** group allows you to control the display of all the contour lines in your graph. To do this, select the **Apply to All** check box. When the check box is selected, you can customize the color, style, and width - for all the lines - from the associated controls.

Customizing the Contour Labels

To control the display of Z level labels in your contour graph, click to select the desired level check boxes. To show or hide all the labels in your graph, click the **Labels** button. This action opens the **Contour Labels** dialog box.



Select the **Keep Current** radio button to maintain your selections from the Color Map/Contours tab.

Alternatively, select the **Show All** or **Hide All** radio buttons to show or hide all the contour labels.

Note: To *add labels* directly in your graph, right-click on the contour line location where you want to display a label and select **Add Contour Label** from the shortcut menu. To *move a label* on a contour line, drag the label to the desired location.

Controlling the Color Map Rescale Mode When the Z or Y Values Change

The **Rescale Mode** drop-down list allows you to control whether or not the Z or Y levels that are established on the Color Map/Contours tab will update if the currently plotted Z or Y values change, or if new data is plotted into the template.

If you select **Normal**, Origin will automatically find the minimum and maximum Z or Y values in your data set, and then create evenly sized Z or Y levels and associated colors.

If you select **Manual**, the current Z or Y levels and associated colors set on the Color Map/Contours tab will remain fixed, independent of the Z or Y range of your data set. To alter the levels and colors, you must edit the Level and Fill controls.

If you select **Fixed From**, the minimum level will remain unchanged, independent of the Z or Y range of your data set.

Alternatively, if you select **Fixed To**, the maximum level will remain unchanged, independent of the Z or Y range of your data set.

The (Plot Details) Numeric Formats Tab

The (Plot Details) **Numeric Formats** tab provides controls for customizing the display of the numeric values for the color map levels. This control includes the level values in the **Level** dialog box, the level list on the **Color Map/Contours** tab, the contour labels in the graph, and the color scale legend in the graph.

Numeric Formats Tab Controls

The Numeric Formats Group

Specify the display format for the color map and contour levels from the Format drop-down list. Select between decimal, engineering, and scientific display. If you select one of the decimal formats, Origin uses a threshold for conversion to scientific notation. This threshold is controlled on the Numeric Format tab of the Options dialog box (**Tools:Options**).

Type a value in the **Divide by Factor** text box to divide all the color map and contour levels by this amount.

Select the **Decimal Places** radio button to control the display of the number of digits after the decimal place. Select the desired value from the associated list box.

Select the **Significant Digits** radio button to control the number of digits displayed. Select the desired value from the associated list box.

Type a prefix or a suffix to append to the color map and contour level labels in the associated text boxes. The prefix and suffix display in the graph. They do not, however, display in the level list on the Color Map/Contours tab. When you type a prefix or suffix, you can use special formatting commands to control the font style (for example, superscript, subscript, and bold).

The Labeling Criteria Group

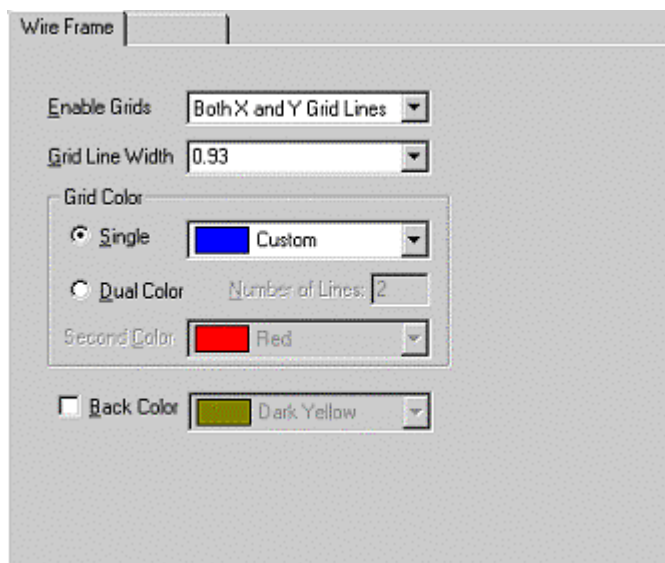
The **Min. Area (%)** combination box can be used to set a percent value such that only contours that have a fraction of the total area larger than the set value will have a label associated with them.

3D Surfaces

The (Plot Details) Wire Frame (or Grids) Tab

The (Plot Details) **Wire Frame** (or **Grids**) tab provides controls for customizing the wire frame or grids for all the surface graphs except the 3D bars. The controls on the tab are identical for each of these surface graphs, except for the grid and fill color controls. These controls are dependent on the type of surface graph you are editing.

Wire Frame (or Grids) Tab Controls



The Enable Grids Drop-down List

Select the grid lines for display in the graph from this drop-down list.

The Grid Line Width

Type or select the desired grid line width from this combination box. The grid line width is in units of points.

The Grid Color Group

For color fill and X or Y constant with base surfaces, select a grid color from the associated drop-down list.

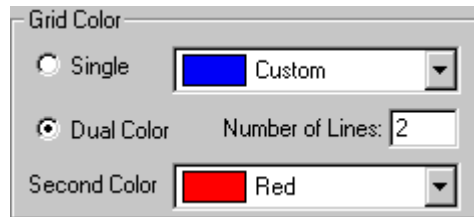
- For color map surfaces:

Select the **Single** radio button to display all the grids using the color from the associated drop-down list. Select the **Use Color Map** radio button to display the grids using the color map established on the **Color Map** tab.



- For wire frames and wire frame surfaces:

For wire frames and wire frame surfaces, select the **Single** radio button to display the grids using the color from the associated drop-down list. Select the **Dual Color** radio button to display additional lines between the surface grid lines. Type the number of additional lines in the **Number of Lines** text box. Select the color for the additional lines from the **Second Color** drop-down list.



The Surface Group

Select the **Back Color** check box to display a color on the back side of the surface. Select the desired color from the associated drop-down list.

The Front Color Drop-down List (Color Fill and X or Y Constant with Base only)

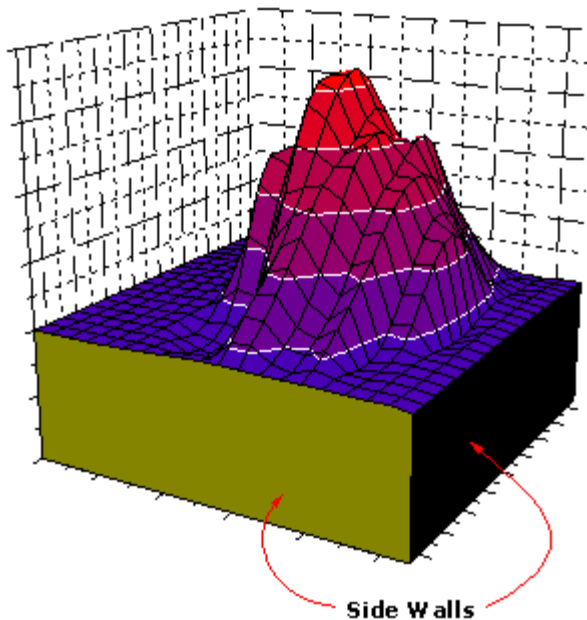
Select the surface color from this drop-down list.

The (Plot Details) Side Walls Tab

Side walls are 2D walls that extend from the height of the surface graph down to the bottom of the **Z** axis range:

- **X** side walls display in the **XZ** plane.
- **Y** side walls display in the **YZ** plane.

The (Plot Details) **Side Walls** tab provides controls for displaying the side walls and customizing their color.



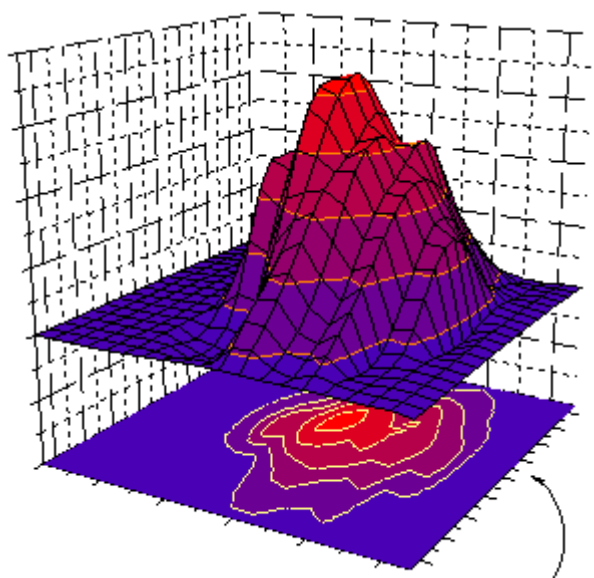
To open the **Side Walls** tab:

1. From the menu, choose **Format:Plot**. This opens the Plot Details dialog box.
2. Select the **Side Walls** tab.
3. Select the **Enable** button to display **X** and **Y** side walls in the graph.
4. Select the desired color from the associated drop-down lists.

5. To hide either the X or Y side walls, select **None** from the associated drop-down list.

The (Plot Details) Surface/Projections Tab

The **Surface/Projections** tab provides controls to edit the surface display of a color map surface graph, as well as the top and bottom contour projections. This tab also provides controls to hide data above or below a specified Z value.



Bottom Contour Enabled

Surface/Projections Tab Controls

	Surface	Top Contour	Bottom Contour
Fill Color	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Contour Line	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Line Color	Orange	White	LT Yellow
Line Width	<input type="text" value="0.5"/>	<input type="text" value="0.5"/>	<input type="text" value="0.5"/>
Z Clipping			
Low (%)	<input type="text" value="0"/>		
High (%)	<input type="text" value="100"/>		

The Surface, Top Contour, and Bottom Contour Controls

To display a fill color on the 3D surface, select the **Fill Color** check box in the **Surface** column.
 To display the fill color as top or bottom contours, select the **Fill Color** check box in the **Top Contour** or **Bottom Contour** column.

Similarly, to display contour lines with the fill color, select the check box associated with the surface or the desired contour. Select the contour line color and width from the associated drop-down lists. The contour line width is in units of points.

The Z Clipping Group

The Z clipping controls allow you to clip the color map surface at the lower or upper axis scale range. Both controls are in units of % of the Z axis scale.

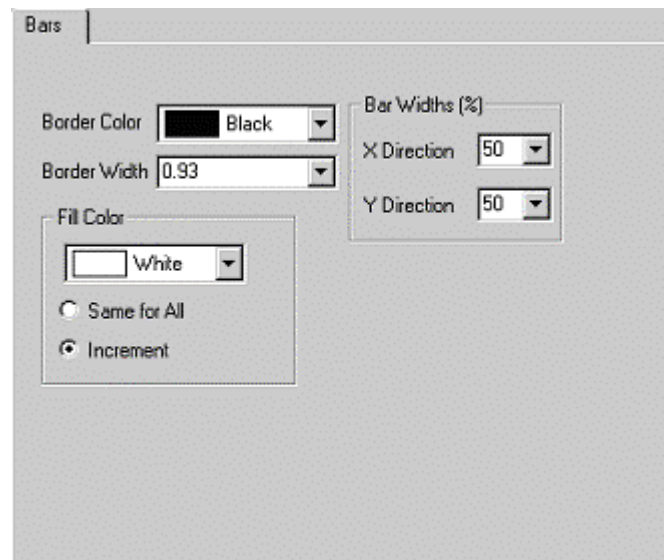
When the **Low (%)** text box is set to **0**, the surface is not clipped at the low end. If you type *n* in this text box, the surface that is associated with the lower *n%* of the Z axis scale is clipped from view.

When the **High (%)** text box is set to **100**, the surface is not clipped at the high end. If you type *n* in this text box, the surface above *n%* of the Z axis scale is clipped from view. For example, type **75** to clip the surface associated with the top **25%** of the Z axis scale range.

The (Plot Details) 3D Bars Tab

The **Bars** tab provides controls to customize the display of 3D bar graphs. These controls include the bar border and fill, as well as the bar widths.

3D Bars Tab Controls



The Border Color Drop-down List

Select a border color from this drop-down list.

The Border Width Combination Box

Type or select a border line width from this combination box. The border line width is in units of points.

The Fill Color Group

Select the **Same for All** radio button to display all the bars using the same color. Select the bar color from the associated drop-down list.

Select the **Increment** radio button to increment the bar color along the Y axis. Select the start color from the associated drop-down list. Origin increments through the color palette.

The Bar Widths (%) Group

Type or select a value from the **X (Y) Direction** combination box to set the thickness of the bars along the X or Y axis.

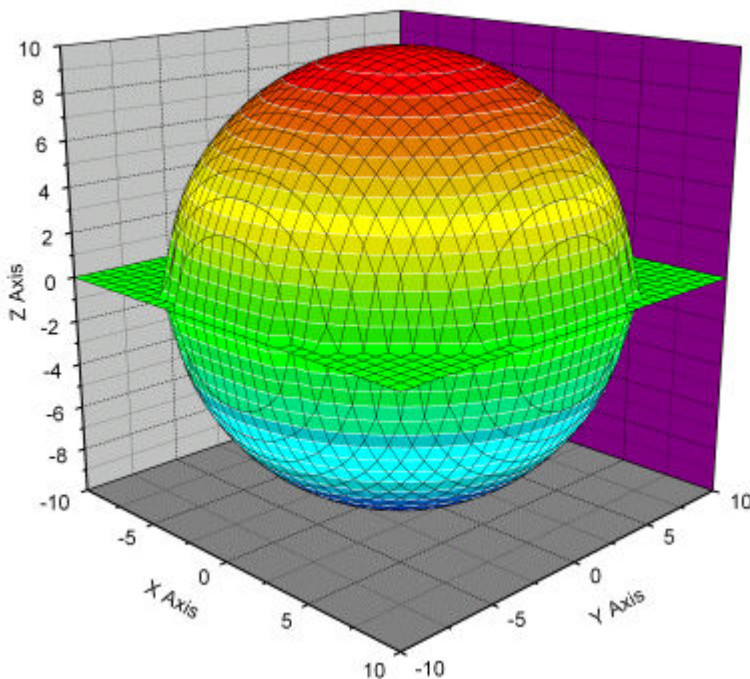
The combination box is in units of % of the **X (Y)** axis increment.

Displaying Multiple 3D Surfaces or a 3D Surface and Multiple 3D Scatter Data Plots

Origin allows you to plot two surfaces or one surface and multiple 3D scatter data plots in the same graph layer using the **Layer *n*** dialog box. However, when you combine these data plots in a layer, Origin does not perform any calculations concerning the intersections of the data plots, and thus no information can be inferred by any visual indication of an intersection.

For example, while it is possible to display two surfaces in a surface plot, Origin simply draws one surface and then draws the second surface as if the first one didn't exist. Thus, you can create two hemispheres (from two matrices) and have them draw in the correct sequence so as to appear like a complete sphere, but rotation of this figure may produce a visually confusing image.

View of 2 Hemispheres that Appear to Form a Complete Sphere



Additionally, you can include a 3D surface and 3D scatter points (with or without drop lines) in the same graph layer. However, close inspection of the drop lines may appear to indicate that some points are floating above the surface as if they were calculated incorrectly or displayed in the wrong location. However, this is an artifact of the drawing routine.

Because the scatter data points and the "corners" of the polygons that represent the 3D surface (Origin uses a polygon rendering method to draw 3D surfaces) occupy the same points in space, the "back to front" drawing method used by Origin does not include a process to further sort the drawing order. In some cases, the scatter point is drawn first (with its drop line) and subsequently drawn polygons will cover up parts of the scatter data point. However, in other cases the polygons that share this point in space are all drawn first

and the scatter point and drop line are drawn on top. Another polygon may draw over parts of the drop line from a scatter point, giving the illusion that the drop line intersects the surface at some distance away from the scatter data point.

You can verify that all points lie on the surface by rotating the figure to view the surface edge-on. Removing perspective will reveal that all the scatter points lie exactly on the surface.

Customizing Grouped Data Plots

Group Incremental Lists

When multiple worksheet columns are selected and plotted through the **Plot** menu (or from one of the graph toolbars), data sets are -- by default -- *grouped* within a graph layer. Use **Group Incremental Lists** to automatically assign a visually distinct set of plot characteristics to each data set in the group. This feature works by incrementing through the members of a style list for each plot element -- Line Color, Symbol Type, Line Style, etc. -- that you have chosen to increment. In addition to choosing which elements to increment, you can customize the Group Incremental Lists themselves, adding, removing, and rearranging list members as needed and you can name and save Group Incremental Lists for future use.

Further, you can specify that plot elements - Line Color, Symbol Type, Line Style, etc. -- increment in either a **Concerted** or **Nested** fashion. When elements increment in a Concerted fashion, all elements that are set to increment will cycle through their member lists independently. When elements increment in a Nested fashion, you establish a hierarchy of elements in which all members of the first element list are exhausted before the members of the second element list are incremented:

1 st element list	Line Color	<input checked="" type="checkbox"/>	Red Green Blue
2 nd element list	Symbol Type	<input checked="" type="checkbox"/>	△ ▷ ▽ ◀
3 rd element list	Line Style	<input type="checkbox"/>	— - - - -
Etc.	Symbol Interior	<input type="checkbox"/>	■ □ ○ ▣

In the above example, when Nested behavior is chosen, the first *three* grouped plots would use: Red, Green, Blue (for lines, symbols, etc.) but *all* three would use the upward pointing triangle for a symbol shape. Only when the *fourth* data set in the group was plotted would the rightward-pointing triangle symbol be used; the fifth and sixth data sets would use the same symbol shape, the seventh, eighth and ninth would use the downward-pointing triangle, etc. The three color/four symbol shape lists in this example could be used to assign a unique plot to each of 12 data sets without incrementing another plot element (such as line style, symbol interior, etc.).

Open the **Group** tab of the **Plot Details** dialog box (To open, activate the graph window and choose **Format:Plot** from the Origin menu) to control these Group Incremental List behaviors:

- Whether or not a particular plot element is incremented according to the members of a list.

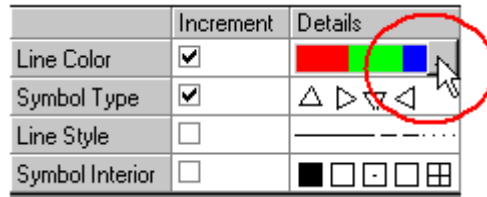
To set a plot element to automatically increment:

1. Select the check box in the **Increment** column next to the element -- Line Color, Symbol Type, etc. -- that you want to vary.

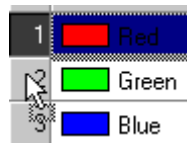
- What the list contains.

To modify an Increment List:

1. Right-click once at the right edge of the **Details** column. A "browse" button will appear.



2. Click once on the browse button to open the Incremental List dialog.
3. Drag list members to rearrange the list.



4. Right-click on the list to **Add** or **Delete** colors from the list or to **Save** a List as a Theme (.OTH) file or **Load** a previously saved .OTH file.
5. To replace any member of the list, click once on the list member and make your selection from the drop-down list.

- Whether incrementing occurs in a Concerted or Nested fashion.

To choose between Nested or Concerted incrementing behaviors:

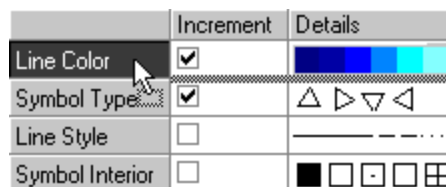
1. Right-click anywhere in the Group Incremental List controls and choose **Nested** or **Concerted** from the shortcut menu.



- The order of (Nested) element lists.

To reorder the plot elements:

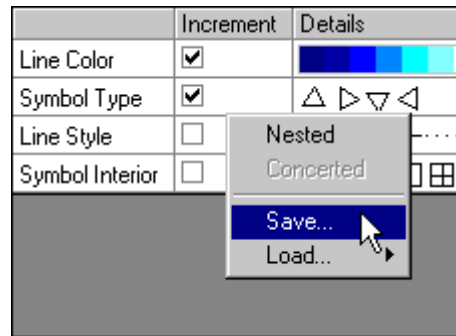
1. Drag the list of elements.



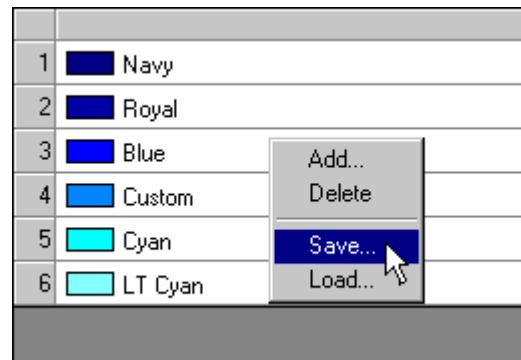
- Saving a Group Incremental List.

To save a List:

1. Right-click anywhere in the Incremental List controls and choose **Save...**. Note that if you Save from this location, you save all lists of elements plus incrementing behaviors.



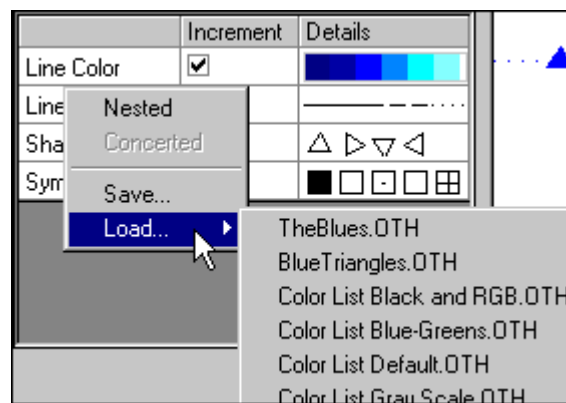
If you save from inside one of the element lists, you save only the members of the list:



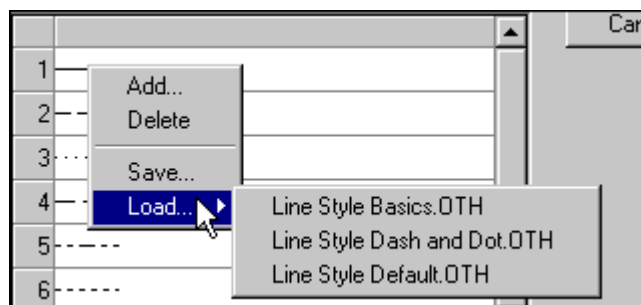
- Loading a Group Incremental List.

To load a List:

1. Right-click anywhere in the Incremental List controls and choose **Load....** Note that if you Load from this location, all .OTH files are listed.



If you load from inside one of the element lists, you can only choose from relevant .OTH files:



Independent Editing of Grouped Data Plots

This is not the preferred method for customization of grouped data plots because settings cannot be saved to a Theme/Group Incremental List for use with other grouped data plots. You can, however, save settings to a graph template file.

To edit grouped data plots independently:

1. From the menu, select **Format: Plot**.
2. Select the **Group** tab.
3. Select the **Independent** radio button.



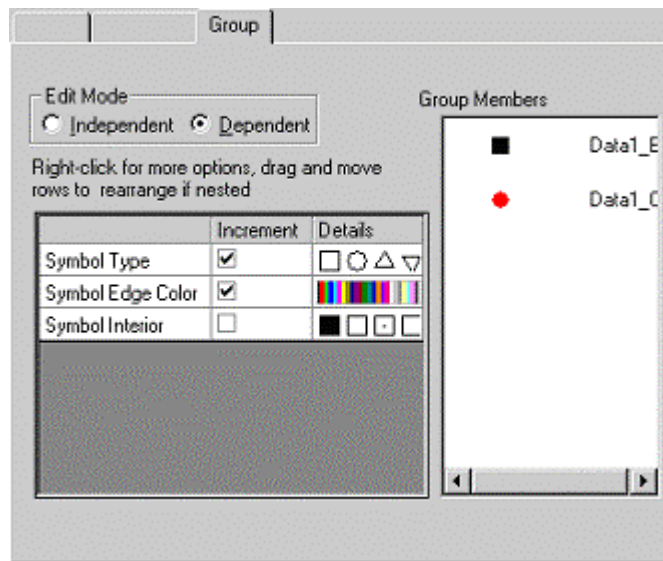
You are now free to edit the grouped data plots independently. Note, however, that the data plots are still grouped; if you return to the Group tab and reselect the Dependent button, plot characteristics will change according to the settings and incremental lists on the Group tab.

The (Plot Details) Group tab

When you open the **Plot Details** dialog box and select a data plot icon on the left side of the dialog box that is part of a data plot group for which the plot attributes increment automatically, Origin displays the **Group** tab. The controls available on this tab vary depending on the graph type and the display selections that have been made on other Plot Details tabs.

If you are unfamiliar with the concept of Group Incremental lists and the customizing of grouped data plots, please see page 358 for a better explanation on the use of these page controls.

Group Tab Controls



The Edit Mode Group

Select the **Independent** radio button to format the display properties of the data plots in the group independently.

When the **Dependent** radio button is selected, the individual data plot icons in the left-hand pane of the Plot Details dialog box are *not selectable* -- the individual data plots *cannot be edited in this state*.

Selecting **Independent** allows you to edit the display properties -- symbol shape, line style, etc. -- of any data plot in the group.










Select the **Dependent** radio button to enable the incrementing controls below these radio buttons.

Note: The preferred method for customizing grouped data plots is to develop your own Group Incremental Lists.

The Increment Controls

Use these controls to customize the appearance of grouped data plots and, simultaneously, develop Group Incremental Lists.

This figure shows a typical incremental list for a 2D scatter plot:

	Increment	Details
Symbol Type	<input checked="" type="checkbox"/>	   
Symbol Edge Color	<input checked="" type="checkbox"/>	
Symbol Interior	<input type="checkbox"/>	   

The first column is a list of plot elements. The second column (**Increment**) lists those elements that are currently incremented by data set. The third column (**Details**) is actually a set of controls for constructing incremental lists.

Use the controls in this box to:

- Specify whether or not a particular plot element is incremented according to the members of a list.

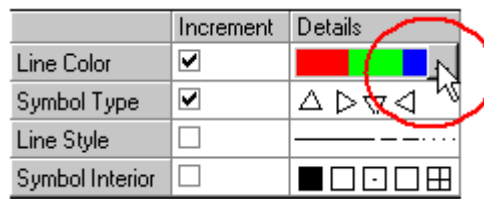
To set a plot element to automatically increment:

1. Select the check box in the **Increment** column next to the element -- Line Color, Symbol Type, etc. -- that you want to vary.

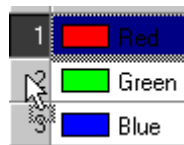
- What the list contains.

To modify an Increment List:

1. Right-click once at the right edge of the **Details** column. A "browse" button will appear.



2. Click once on the browse button to open the Incremental List dialog.
3. Drag list members to rearrange the list.



4. Right-click on the list to **Add** or **Delete** colors from the list or to **Save** a List as a Theme (.OTH) file or **Load** a previously saved .OTH file.
5. To replace any member of the list, click once on the list member and make your selection from the drop-down list.

- Whether incrementing occurs in a Concerted or Nested fashion.

You can specify that plot elements - Line Color, Symbol Type, Line Style, etc. - increment in either a **Concerted** or **Nested** fashion. When elements increment in a Concerted fashion, all elements that are set to increment will cycle through their member lists independently. When elements increment in a Nested fashion, you establish a hierarchy of elements in which all members of the first element list are exhausted before the members of the second element list are incremented.

To choose between Nested or Concerted incrementing behaviors:

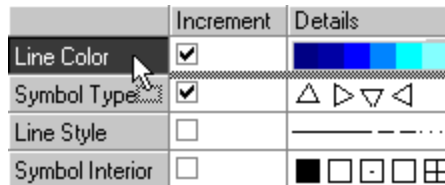
1. Right-click anywhere in the Group Incremental List controls and choose **Nested** or **Concerted** from the shortcut menu.



- The order of (Nested) element lists.

To reorder the plot elements:

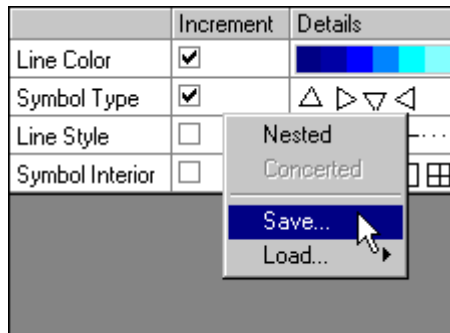
1. Drag the list of elements.



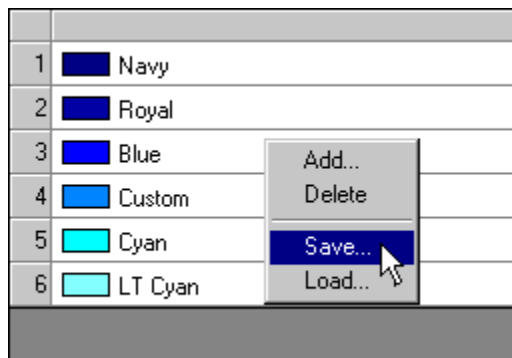
- Saving a Group Incremental List.

To save a List:

1. Right-click anywhere in the Incremental List controls and choose **Save...**.
Note that if you Save from this location, you save all lists of elements plus incrementing behaviors.



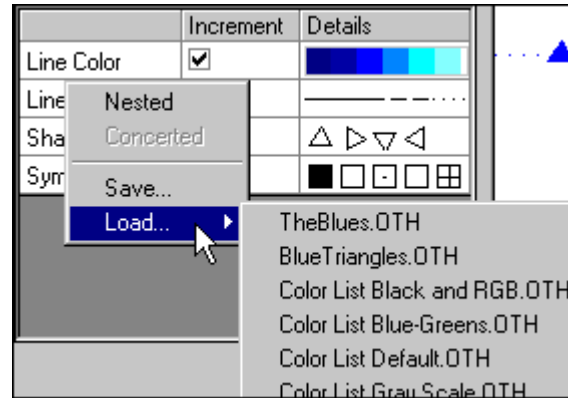
If you save from inside one of the element lists, you save only the members of the list:



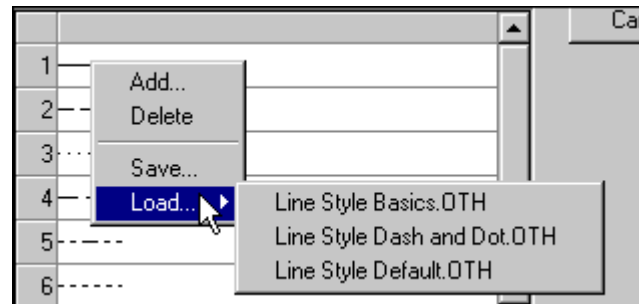
- Loading a Group Incremental List.

To load a List:

1. Right-click anywhere in the Incremental List controls and choose **Load...**.
Note that if you Load from this location, all .OTH files are listed.



If you load from inside one of the element lists, you can only choose from relevant .OTH files:



The Group Members Preview Box

This view box displays current plot attributes for all the data plots in the group. The view box updates as you change selections on the **Group** tab or on the associated Plot Details dialog box tabs.

Exchanging Graphics Between Graph Windows

Copying Graphs Between Pages

To copy a graph, including any labels or data, from one graph window to another, do the following:

1. Select the graph layer you want to copy by clicking on the axis to generate a highlighted boundary.
2. Select **Edit:Copy**.
3. Click in the destination graph window. (Hint: The location in which you click becomes the upper-left corner of the layer.)
4. Select **Edit:Paste**.

Copying the Entire Page of the Active Graph Window (as an Object) to another Graph Window

Origin provides the option of copying a graph, as an object, from one graph window to another graph window.

To add a graph, as an object, to a graph window:

1. Select the graph window containing the graph you want to copy.
2. From the menu, select **Edit:Copy Page**.
3. Select the destination graph window, right-click and select **Paste** from the shortcut menu.

Merging and Extracting Graphs

Merging Graph Windows

Select **Edit:Merge All Graph Windows** to copy the contents of the pages in all the graph windows and place them into either:

- A new merged window; in this case the old graph windows are retained.
- The page of the currently active graph window; in this case, the old graph windows are *not* retained.

Note: Only graph windows in Project Explorer folders that are visible in the workspace are included in the merge operation. Of these, minimized or hidden graph windows are excluded from the merge operation.

Before merging, Origin asks if you want to keep the old graph windows. If you click **No**, Origin will prompt you one final time before continuing with the merge operation.

Origin merges the graph windows by following the graph window order in the **Window** menu window list. The first graph window in the list becomes layer 1 in the merged graph window. The second graph window in the list becomes layer 2 in the merged graph window, etc. If any graph window includes multiple layers, those layers are added to the merged graph following the layer order in the original graph.

After the merged graph is created, you can exchange the position of any two layers using the Layer tool.

You can also exchange the layer number (not position) of any two layers using the following object method:

page.reorder(Layer1, Layer2) (ENTER)

where *Layer1* and *Layer2* are the layer numbers that you want to swap. For more information, see the LabTalk Help file.

To “undo” a merge operation, click the Extract to Graphs button on the Graph toolbar.

How Merging Affects Linked Layers

Any links that existed between layers before merging are preserved by the **Merge All Graph Windows** menu command. Thus, if a graph window contains two layers, and layer 2 is linked to layer 1, then after the merge process this layer linking arrangement will still exist (although the layer numbers may change).

In addition to preserving links, Origin also preserves your custom axis link settings (on the Link Axes Scales tab of the Plot Details dialog box). If you linked layers spatially by selecting % of Linked Layer from the Units drop-down list on the Size/Speed tab of the Plot Details dialog box, then Origin also maintains the spatial relationship between the two layers. This can cause an unexpected layer arrangement in the merged graph window. To avoid this, remove the spatial link between layers before merging by selecting % of Page from the Units drop-down list.

Converting a Multiple Layer Graph Window into Multiple Graph Windows

To convert a multiple layer graph window into multiple graph windows with single layers:

1. Click the **Extract to Graphs** button on the Graph toolbar.

All layers are extracted to individual graph windows, even if a layer is linked to another layer. The original graph window is not saved during the extraction process.

Hiding and Deleting Plot Elements

Hiding Data Plots

Origin provides an option to hide a single data plot, all data plots in the layer except for the selected data plot, or all data plots in the active graph window.

To hide a single data plot:

1. Right-click on the desired data plot and select **Hide Data Plot** from the shortcut menu.

To view the hidden data plot, right-click in the respective layer and select **Show All Data** from the shortcut menu.

To hide all data plots in the layer except for the selected data plot:

1. Right-click on the data plot you want to view and select **Hide Others** from the shortcut menu.

To view the hidden data plots, right-click in the respective layer and select **Show All Data** from the shortcut menu.

To hide all data plots in the active graph window:

1. Select **View:Show:Data**. This action removes the check mark next to the command and hides the data plots in the graph window.

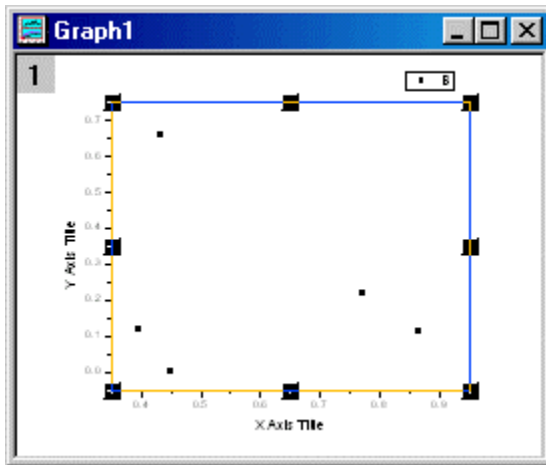
To view all the data plots in the active graph window, reselect **View:Show:Data**.

Note: Hiding data plots reduces the screen redraw time. Additionally, hiding data plots may make it easier for you to see the result of any axis, or axis label, manipulation. However, if you want the data plot included in a printout, remember to display the data plot before printing.

Deleting Layers

To delete a layer:

1. Select the layer by clicking once inside the layer. A highlighted boundary with control handles displays around the layer.



1. Press DELETE.

or

1. Right-click on the active layer's layer icon and select **Delete Layer** from the shortcut menu.

Hiding Labels, Data, and Layers

In addition to controlling the redraw criteria of a graph window, you can hide labels (objects) and data plots in your graph window to reduce the graph window redraw time.

To hide labels on the page:

1. De-select the **View:Show:Labels** menu command. Labels display when this menu command is checked.

To view the labels, re-select **View:Show:Labels**.

Note: To print a graph with hidden labels (and other objects), re-select the **View:Show:Labels** menu command before printing.

To hide all data plots on the page:

1. De-select the **View:Show:Data** menu command. Data plots display when this menu command is checked.

To view the data plots, re-select the menu command.

or

1. Right-click on a data plot and select **Hide Data Plot** or **Hide Others** from the shortcut menu. The **Hide Data Plot** menu command hides the selected data plot. The **Hide Others** menu command hides all data plots in the layer except the selected data plot.

To display the data plots, right-click in the layer and select **Show All Data** from the shortcut menu.

To hide the non-active layers on the page:

1. De-select the **View:Show:All Layers** menu command. The layers display when this menu command is checked.
2. To re-display the layers, re-select the **View:Show:All Layers** menu command.

To hide a specific graph layer:

1. Right-click on a layer icon and select **Hide Layer** from the shortcut menu. This menu command hides the layer associated with the layer icon.
2. To re-display the layer, re-select the shortcut menu item (clearing the check mark).

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The Graph: Templates and Themes

Creating a Custom Graph Template

The basic procedure for creating a custom graph template is the same, whether creating a new template or modifying an existing template:

1. You open a child window based on a named template file.

Choose as a starting point an existing graph in your Origin project, or create a new graph:

- Create a worksheet, matrix or Excel workbook, highlight some data, and click one of the buttons on one of the graph (2D Graphs, 2D Graphs Extended, or 3D Graphs) toolbars.
- Create a worksheet, matrix or Excel workbook, highlight some data, and select **Plot:Graph Type** from the Origin menu.
- Create a worksheet, matrix or Excel workbook, highlight some data, and select **Plot:Template Library** (most applicable to 2D and a few 3D plot types).
- Open a previously-saved graph window file.
- Open an empty template file and add data to the template either by (a) drag-and-drop or (b) the **Plot Setup** dialog box or (c) through the **Layer n** dialog box (most applicable to 2D and a few 3D plot types).

2. You customize the window.

Graph customization is discussed under various topics. See *The Graph: Customizing* on page 289.

To learn more about what customizations are saved with the template, see *Attributes Saved with a Graph Template* on page 145.

3. You save the template.

With the graph window active:

1. Select **File:Save Template As** from the Origin menu. This menu command opens the **Save As** dialog box with the **Save as Type** drop-down list set to **Graph Template (*.OTP)**.
 - To modify the existing template, save your customizations to the default file name.
 - To create a new template, type a new name in the **File Name** text box.

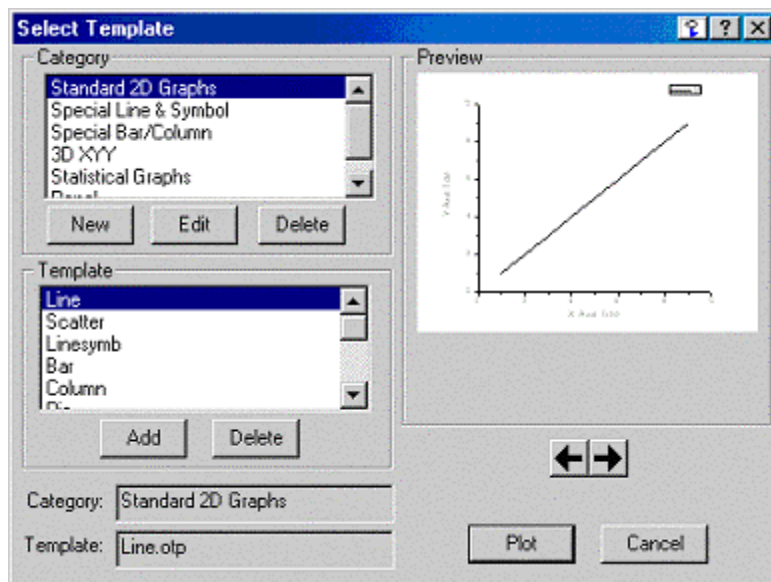
Note that you can also choose or create a **Category Name** for your graph template. Categories help you organize your templates so that they are easier to find when creating new graphs.

2. Click **Save** to close the dialog box and save the custom template.

The instructions on rebuilding the graph window are saved with the template. Data plots are *not* saved with the template.

The Graph Template Library

Use the Template Library tool to plot your worksheet or Excel workbook data.






- If you highlight data in the worksheet or workbook before opening the tool, and your data selection is appropriate for the template you select, then clicking the **Plot** button will plot the selected data into the template.
- If you do *not* highlight data or if your data selection is not appropriate for the template you selected, then clicking the **Plot** button would open the intermediary Plot Setup dialog box for data selection.

To create a graph using the Template Library tool when a worksheet or an Excel workbook is active:

1. With an Origin worksheet or Excel workbook active, select **Plot:Template Library**.

or

1. Click the **Template** button  on the 2D Graphs Extended toolbar. The menu command and toolbar button open the **Select Template** tool.
2. Select a template **Category**.
3. Select your template from the **Template** group (you can scroll through all the templates in a category by clicking the   buttons).
4. Click the **Plot** button to plot the data into the selected template.

Note: Plotting directly to a saved template (as is done using the Template Library) is not possible with all of Origin's built-in graph types (e.g. 3D surfaces and ternary graphs).

Copying Formats and Creating Themes


Copying and Pasting Formats Between Graph Windows

To copy a format and apply it to another graph or graph object:

1. Create and customize your graph or graph object.
2. Right-click on the customized graph or graph object (text object, arrow, etc.) and select **Copy Format**.
3. Choose from **All**, or a subset of All such as **All Style Formats**, **Colors**, **Fonts**, etc.
4. To apply the formatting of the customized graph or object to another graph or object, select a target graph or graph object, right-click, and select **Paste Format**.

... or, to edit or selectively apply formatting to the target:

4. Select a target graph or graph object, press SHIFT, right-click and select **Paste Format** from the shortcut menu. This opens the **Apply Formats** dialog box. Use this dialog box to **Delete Properties** or edit list **Values**.
 1. Specify the target (**Selection**, **Active Graph**, **All Graphs in this folder**, **All Graphs in this Project**).
 2. Specify the source using the **Apply All** or **Apply Selected** buttons.
 - **Apply All** settings in the **Property/Value** list.
 - To apply only *selected* Properties/Values, use the SHIFT or CTRL keys, make your selection and click the **Apply Selected** button.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Creating Themes

Saving a Format as a Theme

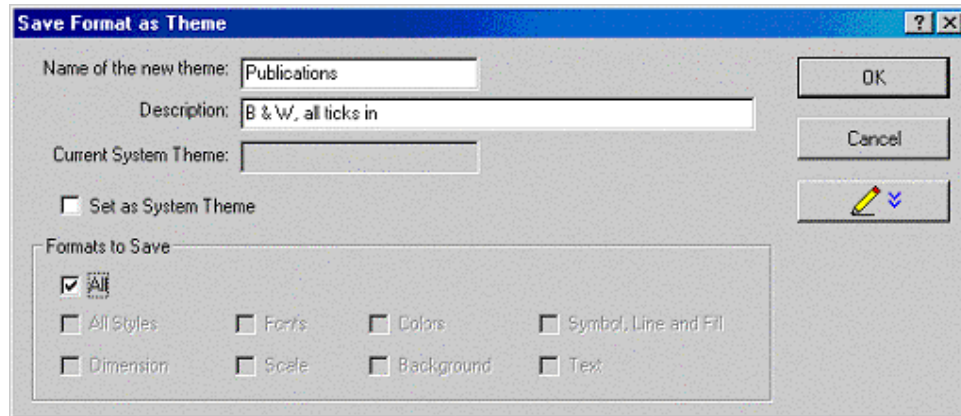
Use the **Save Format as Theme** dialog box to save the object property settings of an existing graph to a theme file; theme file settings can then be applied to future graphs.

To open the **Save Format as Theme** dialog box:

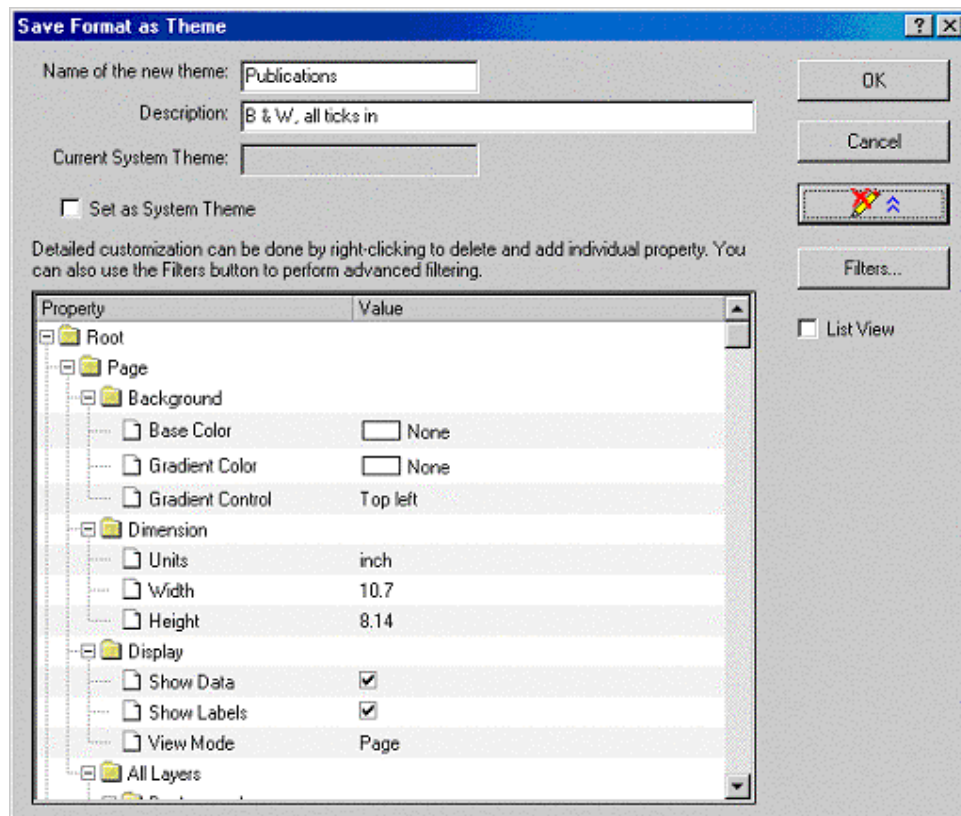
1. Right-click on a graph and choose **Save Format as Theme** from the shortcut menu.

Save Format as Theme Dialog Box Controls

Simple Mode:



Advanced Mode:



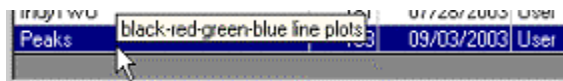
The Name of the New Theme Text Box

Specify a name for your theme file.

The Description Text Box

Use this text box to enter a one-line description of the Theme.

This description will be visible in other Themes dialog boxes (for instance, as a "tool tip" when you select the Theme file in the **Theme Gallery** dialog box).



The Current System Theme View Box

This non-editable text box shows the name of the **System Theme** (optional).

The Set as System Theme Check Box

Select this box to save the Theme file as your **System Theme**.

The Formats to Save Group

The collection of check boxes in this group can be used to determine what style formats to save to the new theme files. The default is **All** (all object property settings in your graph).

If you clear **All**, you can then select just certain format groups such as **All Styles**, or certain format types such as **Color** etc.

The OK Button

Click **OK** to save dialog box settings to a new Theme (.OTH) file.

The Cancel Button

Cancel out of the dialog box without saving the Theme file.

The Edit Theme Details Button ()

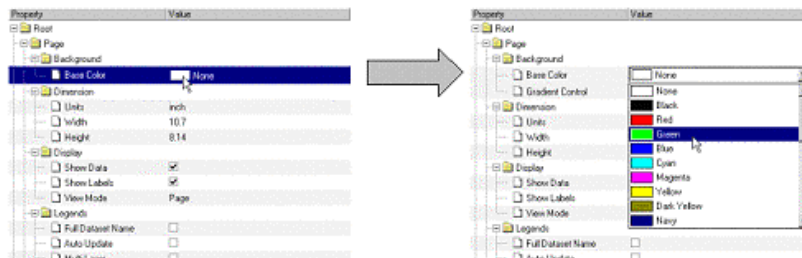
Click this button to expand the **Save Format as Theme** dialog box and make further edits and refinements to your Theme.

Once selected, the **Edit Theme Details** button becomes a **Cancel Edit** button. See *Advanced Mode Controls* (next section) for an explanation.

Advanced Mode Controls

In the lower panel, the Theme parameters are displayed in an expandable tree structure. Specific object format properties are shown in lower level branches. These property values can be changed by:

- Clicking on the **Value** and making a selection from the drop-down list.



- By selecting or clearing check boxes.

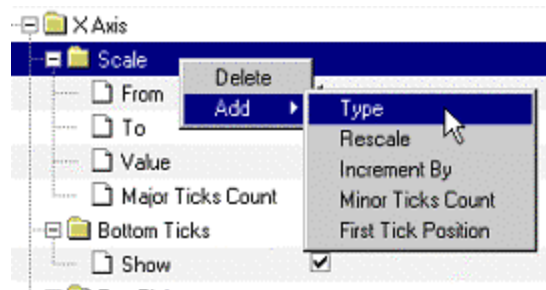


- By typing new values into text boxes.



You can remove a particular property value or property group/node from the tree by right-clicking on the value or property and selecting **Delete**.

Properties applicable to the group/node can be added to a Theme by right-clicking on group/node and selecting **Add**. The context menu then expands to show you what is available to add. Clicking OK then saves the modified theme settings to the new theme file.



The **List View** Check Box

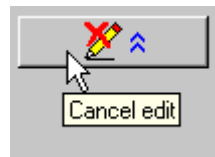
This check box can be used to switch the lower panel display between tree format and list format.

The **Filter** Button

This button opens the **Theme Properties Filtering** dialog box. To learn more, see *Theme Properties Filtering* on page 381.

The **Cancel Edit** Button

When you click the **Edit Theme Details** button, it becomes a **Cancel Edit** button. Click this button to discard any changes that were made to the Theme.

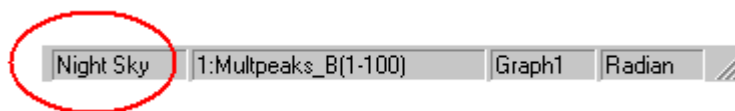


System Themes

What is a System Theme?

A System Theme is handy for applying a uniform set of graph styles -- colors, line widths, fill patterns, tick mark configurations, etc. -- to *every graph* that you make, regardless of the styles that were saved with the template used to create the graph (**see Important Note, below**). You can designate any Theme as a System Theme. Use of a System Theme is optional and there can be only one System Theme at any given time. If

you have designated a System Theme, you will see the name of the Theme displayed on the taskbar in the lower-right corner of the Origin workspace.



Since the property settings in the System Theme will apply to *all* newly created graphs, your System Theme should include *only* those properties that you really want to include in *all* of your graphs. Ideally, a System Theme will consist of only *a few key elements*.

For example, if you would like to apply an "all ticks in" Theme to a number of your graphs, then the System Theme should probably only contain this property and nothing else. This way, as new graphs are created from your various templates, no template settings other than the one that you are specifically concerned with -- tick direction -- are affected by your System Theme (Note that a System Theme for "ticks in" ships with Origin; you can view and/or edit shipped System Themes to learn how a compact System Theme should be built).

Note that you cannot designate Group Incremental Lists as System Themes.

How do you designate a System Theme?

- You can designate a System Theme from the **Save Format as Theme** dialog box. Right-click on a graph window and choose **Save Format as Theme** from the shortcut menu. This opens the Save Format as Theme dialog box. Select the **Set as System Theme** check box.
- You can designate a System Theme from the Theme Gallery. From the menu, choose **Format:Theme Gallery**. Any existing System Theme registers in the **Current System Theme** text box. To designate or swap System Themes, right-click on a Theme and choose **Set as System Theme** from the shortcut menu.

How do you remove the System Theme?

- You can remove the System Theme via the Theme Gallery. From the menu, choose **Format:Theme Gallery**. The System Theme, if any exists, will register in the **Current System Theme** text box; the name will also appear in bold text in the Themes list. To remove the System Theme status from this Theme, highlight the Theme in the list control, right-click and choose **Clear System Theme** from the shortcut menu.

Important Note: Under various scenarios (e.g. you distribute a script application and a graph template file to co-workers to use on their computers, but unbeknownst to you, some of those co-workers are using a System Theme), having an active System Theme may produce unintended results. If you *do not want* the System Theme to override settings saved with your custom template(s), you should do the following:

1. Make a graph using your custom template.
2. Open the Script Window or the Code Builder IDE and issue one of the following commands:

```
PAGE.CNTRL=16; //LabTalk command issued in the Script Window
LabTalk.Page.Cntrl = 16; //Origin C command issued from Code Builder
```

3. Re-save the graph template.

This ensures that custom template settings will not be changed by an active System Theme. This procedure pertains to both user-interface and scripting/programming applications involving use of graph templates.

Theme Gallery

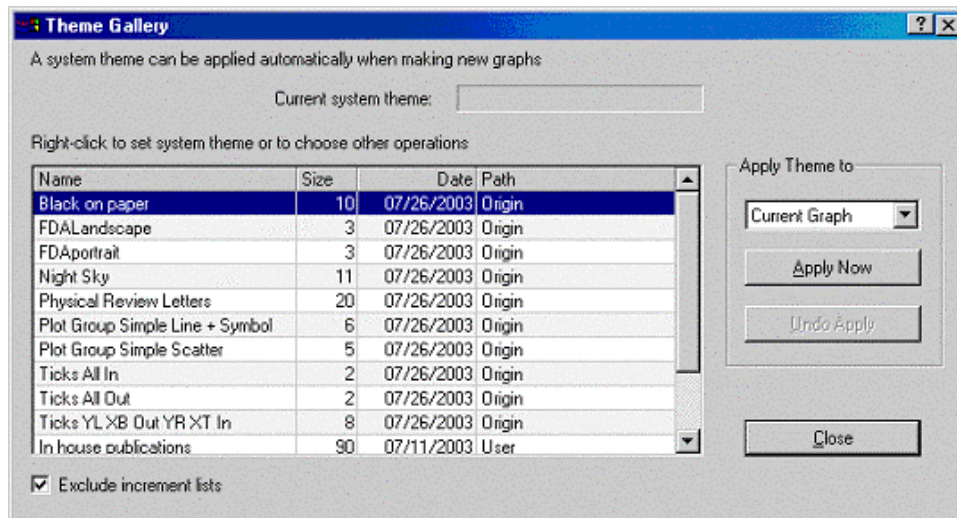
Use the **Theme Gallery** to add, duplicate, delete or apply your Themes, as well as to designate or clear a System Theme. To open the Theme Gallery:

1. From the menu, select **Format:Theme Gallery**.

or

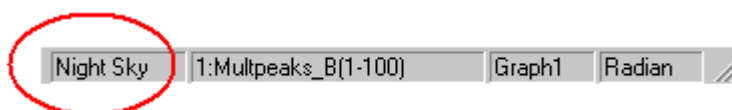
1. Press **F7**.

Theme Gallery Dialog Box Controls



The Current System Theme View Box

This non-editable text box displays the name of the Theme (file) that is designated as the System Theme. This box is blank if no System Theme has been chosen. Note that if a System Theme is chosen, this name also displays in the status bar to the lower right of the Origin workspace.



The Themes List Control

The list control in the center of the dialog box displays all theme files. These files are saved in two places:

- Themes that ship with Origin are stored in the \Themes folder under the Origin program folder.
- Themes that you create using the **Save as Themes** dialog box, are saved to a \Themes subfolder in the User Files folder.

List Control columns:

Name: (Disk File) name of the Theme file.

Size: Size of the Theme file.

Date: Date of creation.

Path: Disk location of the theme file; either **Origin** (themes shipped with Origin) or **User** (user-created theme files).

Shortcut Menu Commands Available by Right-Clicking on List Controls:

Add new: This creates a new, blank Theme file. You then build up this empty Theme file by going into **Edit** mode (see next).

Edit: This brings up the **Theme Editing** dialog, allowing you to edit the highlighted Theme. To learn more, see *Theme Properties Editor* on page 380.

Delete: Delete the selected (highlighted) Theme. Note that this does not actually delete the theme file, but, instead moves it to a subfolder under \Themes, called \Deleted. This allows you to resurrect Themes by manually moving the Theme file from the \Deleted subfolder back into the \Themes folder.

Duplicate: This duplicates the selected (highlighted) Theme file and renames it **Copy of Theme**. To rename the Theme, double-click on the Theme **Name**.

Combine: You can SHIFT + Select multiple Theme files, then select this shortcut menu command to create a Theme file that combines the selected files. If there are duplicate items, the property value of the first encountered occurrence is taken and the later ones are ignored.

Set as System Theme: Set the selected (highlighted) Theme as the System Theme.

Clear System Theme: Clear the current System Theme (set as "none").

Show Tooltips: Show ToolTip when mouse is placed over a theme file name – the ToolTip is the Theme file **Description**, assigned when the Theme was saved.

The Exclude Incremental Lists Check Box

This check box is selected by default. If this checkbox is cleared, then Group Incremental Lists are also listed in the **Themes List Control** (see above).

Incremental Lists apply only to plot groups. Such Incremental Lists can be created from the Plot Details dialog box. To learn more, see *Group Incremental Lists* on page 358.

Note that Incremental Lists cannot be designated as System Themes.

The Apply Theme To Group


The drop-down list setting determines which graphs the selected Theme will be applied to. The options are:

- **Current Graph:** Apply Theme to active graph. If active page is not a graph page, the **Apply Now** button (see below) is grayed out.
- **Graphs in Folder:** Apply Theme to all graphs in current Project Explorer folder.
- **Graphs in Project:** Apply Theme to all graphs in the project.

The **Apply Now** Button: Once you set the drop-down list above, click this button to apply the selected Theme.

The **Undo Apply** Button: Undo the application of the selected Theme.

The **Close** Button: Close the dialog box.

 See your Origin software to view a multimedia demonstration on this topic ([Help:Multimedia Demonstrations](#)).

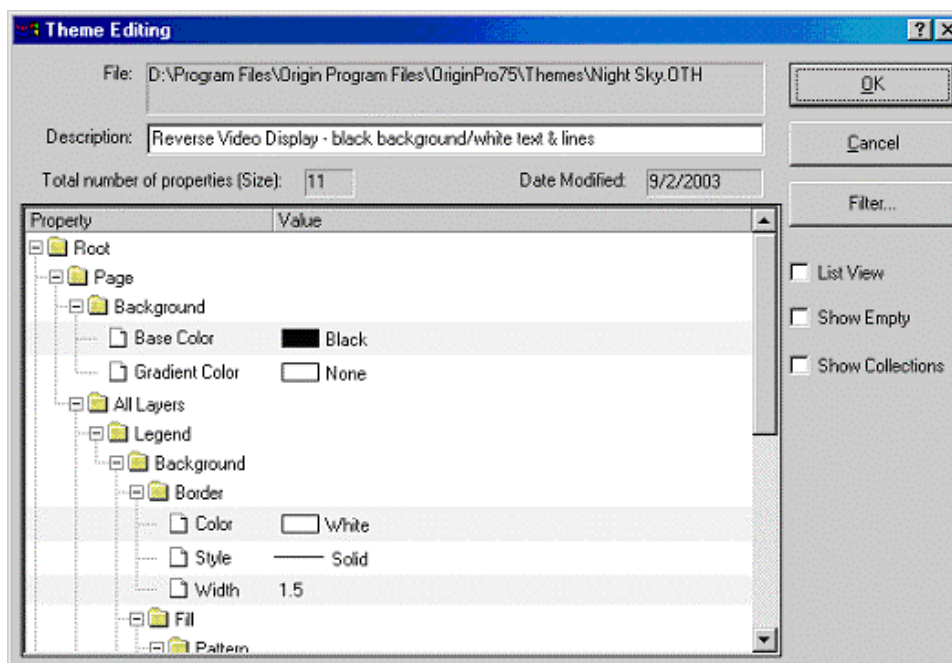
Theme Editing

Use the **Theme Editing** dialog box to edit an existing theme.

To open the Theme Editing dialog box:

1. From the menu, choose **Format:Theme Gallery**.
2. Right-click on a theme in the **Theme Gallery** and select **Edit** from the shortcut menu.

Theme Editing Dialog Box Controls

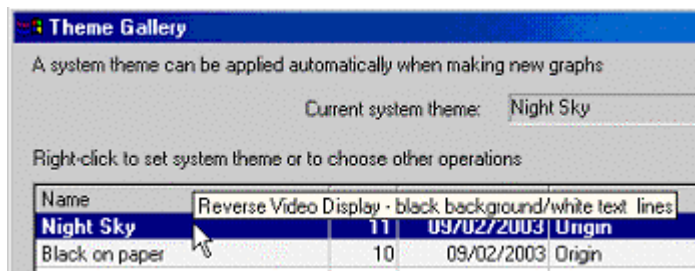


The File View Box

This non-editable box displays the full path and name of the Theme file being edited.

The Description Text Box

This is an editable, one-line description of the Theme. This description is shown as a ToolTip when you mouse-over a Theme file **Name** in the **Theme Gallery** list control.



The **Total Number of Properties (Size)** View Box

This non-editable text shows the total number of object properties that are currently contained in the Theme. This number will decrease or increase as object properties are removed from or added to the Theme during the editing process.

The **Date Modified** View Box

This non-editable text shows the date of last Theme file modification.

The **Property/Value** List Control

This control lists the Theme contents. The default style for this list is the tree structure. You can toggle on **List View** by checking the List View check box to the right.

You can edit any object property in this tree/list by clicking on the entry in the **Value** column and:

- selecting a new value.
- entering a new value.
- selecting or clearing a check box.

You can also right-click on a property line or a branch of the tree and choose **Delete** from shortcut menu. Similarly, you can right-click on applicable properties or branches of the tree and choose **Add**, to add more properties/branches to the tree. When you Delete or Add, the **Total Number...** control above this list control updates.

The **OK** Button

Write changes to the Theme to file, and close the dialog box.

The **Cancel** Button

Cancel all changes and close the dialog box.

The **Filter** Button

Bring up the **Theme Properties Filtering** dialog box to edit/modify the Theme using filters. To learn more, see *Theme Properties Filtering* on page 381.

The **List View** Check Box

Toggle the list control view of Theme properties between tree mode and list mode.

The **Show Empty** Check Box

Selecting this checkbox shows empty branches in a tree. By default, empty branches are hidden.

Once shown, you can right-click on the empty branch to add elements and expand the Theme.

The **Show Collections** Check Box

Selecting this box displays branches of three that can only have collection members (for example a Layer collection which could contain Layer1, Layer2 etc).

Theme Properties Filtering


This dialog provides an alternate way of editing Themes, by subtractive filtering of the object property collection in the Theme using category and property type filters. By de-selecting various Category or Property Filters and clicking **Apply** Filter, you reduce the number of properties in the Theme. This dialog is accessible while editing a Theme.

To open the **Theme Properties Filtering** dialog box:

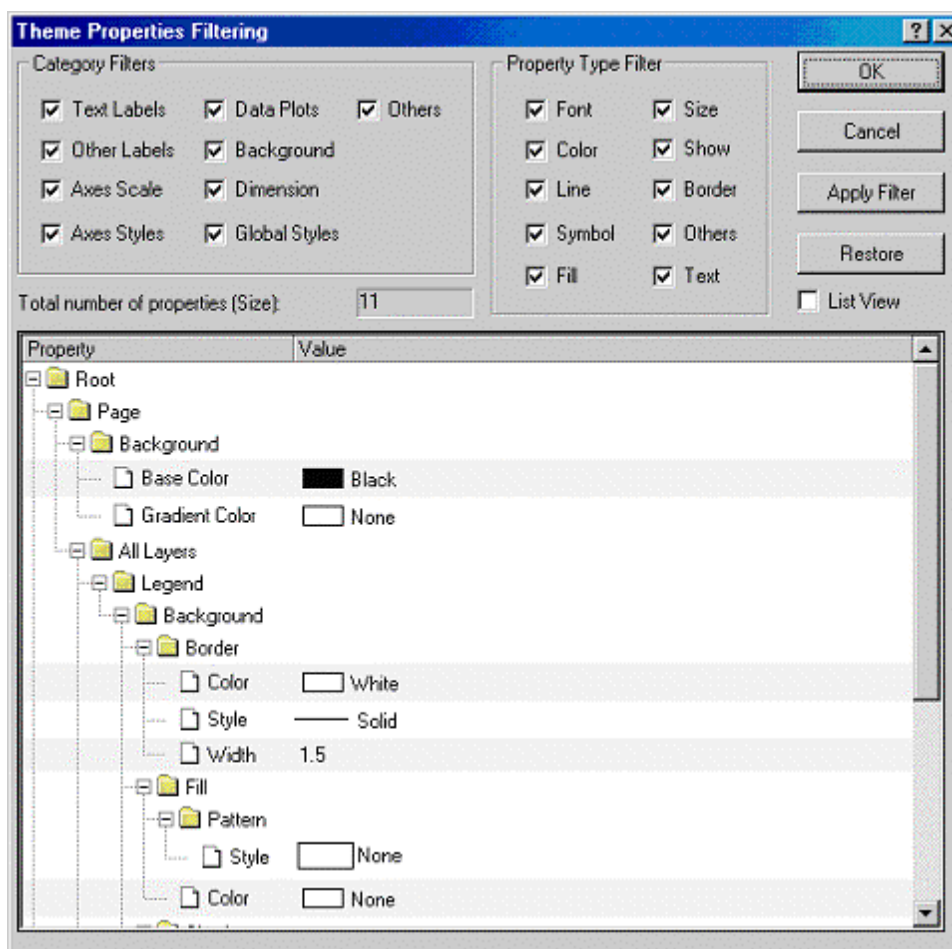
1. Right-click on a Theme in the **Theme Gallery** and choose **Edit**. This opens the **Theme Editing** dialog box.
2. Click the **Filter** button.

or

1. Right-click on your graph and choose **Save Format as Theme**. This opens the **Save Format as Theme** dialog box.

2. Click the **Edit Theme Details** button . This expands the **Save Format as Theme** dialog box.
3. Click the **Filters** button.

Theme Properties Filtering Dialog Box Controls



The Category Filters Group

Use these controls to exclude certain categories from the Theme file.

To remove all property entries in the theme which correspond to a category:

1. Clear the corresponding check box.

- Click on the **Apply Filter** button to the right side of the dialog box.

Example: If you clear **Axes Scale** and click **Apply Filter**, all object properties related to axes scales (if they exist) will be excluded from the Theme. The **Total Number of Properties (Size)** view box will update.

Click **Restore** to restore Theme settings (those which existed when the dialog box was opened).

The Property Type Filter Group

Use these controls to selectively turn off specific properties in the Theme. Properties may apply to multiple elements; color, for instance, can apply to background color, color of text objects etc.

To filter out all Theme elements corresponding to a property:

- Uncheck a property in this group.
- Click the **Apply Filter**. The Theme is filtered and the **Property/Value** display of member elements is updated in the display below this group. You can restore Theme settings to those that existed when the Filtering dialog box was opened by clicking the **Restore** button.

The OK Button

Close the dialog box and apply selected changes to the Theme.

The Cancel Button

Discard changes to the Theme and close the dialog box.

The Apply Filter Button

Filter the existing theme properties using the conditions set in the **Category** and **Property Type** groups.

The Restore Button

Restore Theme settings to those that existed when the **Filtering** dialog box was opened.

The List View Check Box

Toggle the Theme display between the tree mode and the list view mode.

The Total Number of Properties (Size) View Box

This non-editable text box displays the current number of properties in the Theme. As filters are applied to the theme, this number is decremented.

Clicking **Restore** will restore Theme settings (to those existing at the time that the Filtering dialog box was opened), and restore the original count to this box.

The Property/Value List Control

This control lists the Theme contents -- in tree mode or in list view, depending on the **List View** check box setting. In this **Filtering** dialog box, the Theme particulars are not directly editable; you can only filter them using the **Category** and **Property Type Filters** controls.

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Text and Drawing Objects

Layer Association, Attachment Method and Scaling Considerations

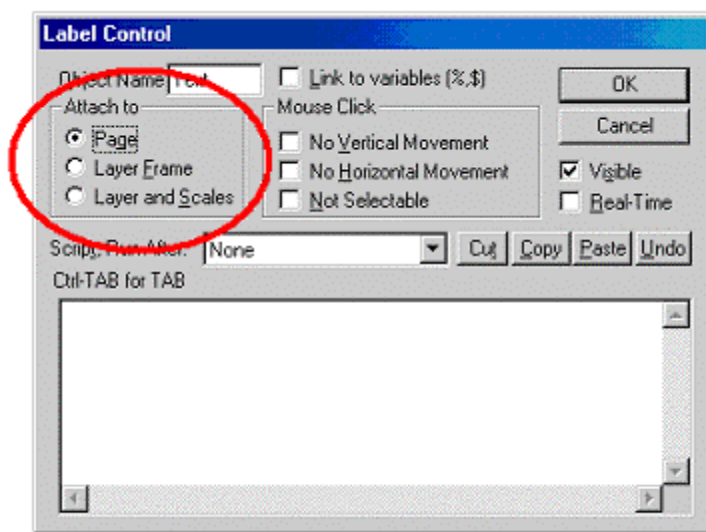
Object Attachment Methods

Controls for object attachment are in the **Attach To** group of the **Label Control** dialog box.

To open the Layer Control dialog box:

1. Select an object.
2. Right-click and choose Label Control from the shortcut menu.

When you create a text or drawing object (line, arrow, circle, etc.) in an Origin graph, worksheet, layout or matrix window, the object is attached to the window by one of three methods:



- **Page.** When attached to the page, the object is both position and scale *independent* of its layer. Object position and size are not affected by moving or resizing the layer, or by changing the axis scale. However, the object remains a part of the layer that was active at the moment of object creation and is deleted if the layer is deleted.
- **Layer Frame.** When attached to the layer frame, the object is position dependent on its layer. When you move the layer, the object moves with the layer. If you resize the layer, the object is resized proportionally and moves with the layer. However, if you rescale the axes (change the axis scale **From** and **To** values), the object's size and position remain unchanged.
- **Layer and Scales.** When attached to layer and scales, the object is positioned in the layer by axis scale values. If you move the layer, the object moves with the layer. If you resize the layer, the object is scaled proportionally and moves with the layer. If you rescale the axes (change the axis scale **From** and **To** values), the object is not resized, but moves in relation to XY coordinate values.

Default Attachment Methods

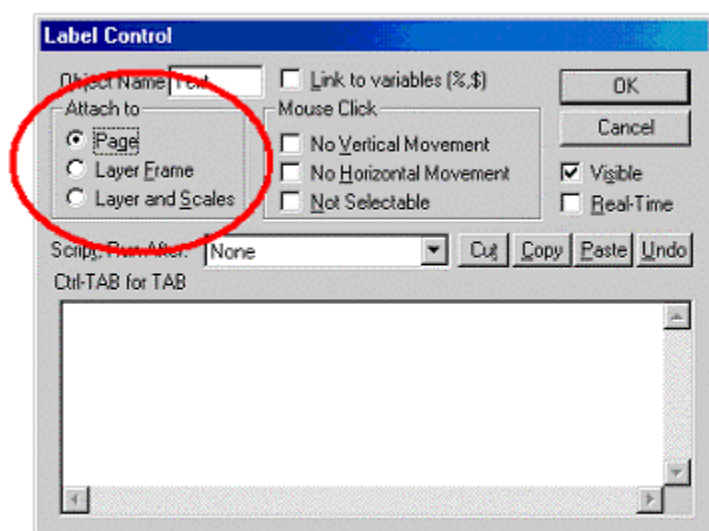
All Origin child windows to which objects can be attached -- worksheets, graphs, matrixes, and layout windows -- have at least one layer but the layer to which the object is attached, and the attachment method, are most relevant to the customization of graph windows. Whether an object is attached to **Page**, **Layer Frame**, or **Layer and Scales** is determined by:

- Object type
- Whether the object is created inside the (graph's) layer frame or outside the layer frame.

Default attachment methods:

Object Type	When Created <i>Inside</i> Layer Frame, Attached to...	When Created <i>Outside</i> Layer Frame, Attached to...
Text, Rectangle, Circle, Polygon, Region, Polyline, Freehand	Layer Frame	Page
Arrow, Line, Curved Arrow	Layer and Scales	Page

Once an object has been created, you can change the attachment method by editing the **Attach To** group in the Label Control dialog box.



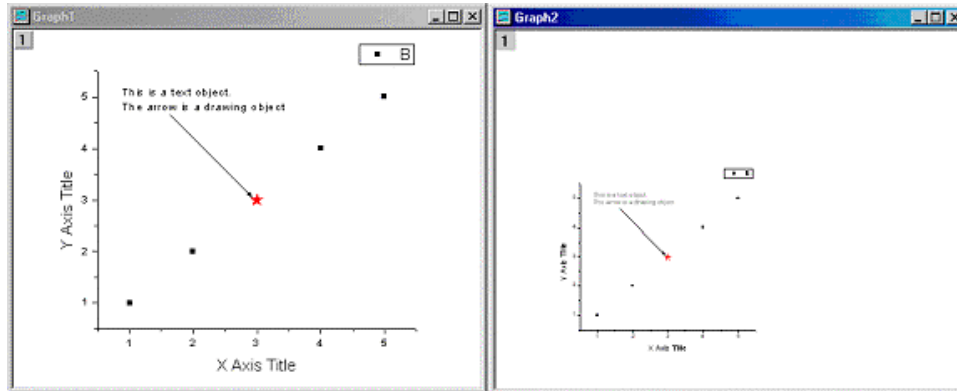
To open this dialog box:

1. Right-click on the object and select **Label Control** from the shortcut menu.
2. Edit the **Attach to** group.

The object attachment method becomes important when resizing and moving graph layers. If an object is attached to the Layer Frame or Layer and Scales, the default behavior is for the object to move or be resized in response to changes in the size or position of the layer frame (Layer Frame and Layer and Scales) or changes in axis scale values (Layer and Scales). To find out how to control the scaling of objects that are attached to the Layer Frame or Layer and Scales, see *Scaling of Objects in Relation to the Size of the Layer Frame* on page 387.

Scaling of Objects in Relation to the Size of the Layer Frame

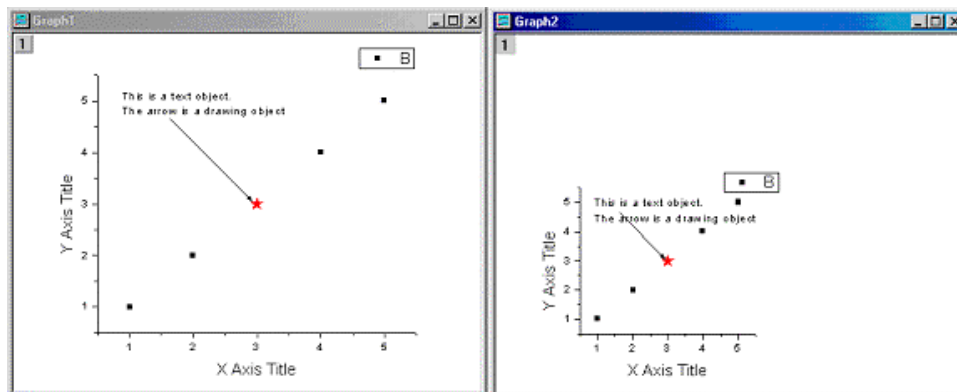
Objects that are attached to the **Layer Frame** or **Layer and Scales** will, by default, scale proportionally to changes in the size of the layer. This graph layer was resized by dragging a control handle on the layer frame. Note that all objects on the graph page -- the added text labels, the arrow, the axis titles, and the legend -- were reduced in size proportionally when the layer was made smaller.



To specify that objects not be resized when changes are made to the size of the layer frame:

1. With the graph active, select **Format:Layer** from the menu. This opens the Plot Details dialog box with the layer icon selected on the left side of the dialog box.
2. Select the **Display** tab.
3. Select **Fixed Factor** and enter a scaling factor (A factor of **1** will fix object size at 100% of created size).

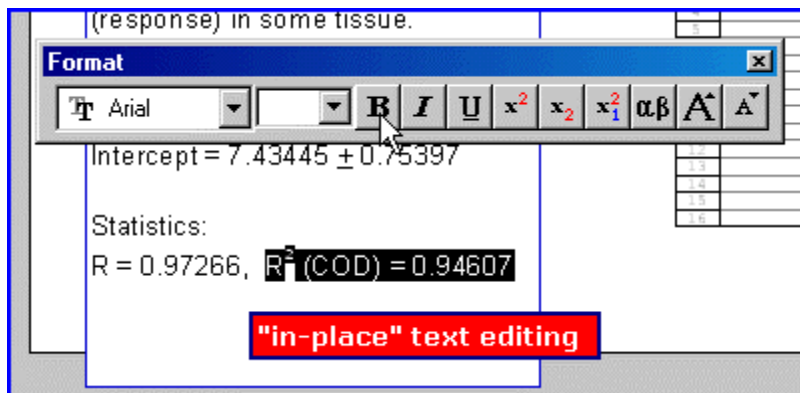
Any changes made to the size of the layer will not produce a proportional scaling of objects that are part of that layer.




Note: Drawing objects (lines, arrows, rectangles, etc.) attached to **Layer and Scales** will continue to rescale because the size of the object is tied to axis scale values.

Text Objects

Creating and Editing Text Labels



To create a new text label:

1. Click the **Text Tool**  button.
2. Click at the desired text entry point on your Origin window.

or

1. Right-click at the desired location in your Origin window.
2. Select **Add Text** from the shortcut menu.

then

3. Select your text format options from the **Format and Style** toolbars and begin typing.

The Format and Style Toolbars



If text is not selected, the toolbar formatting and color options are invoked at the current cursor location. Otherwise, formatting/color selections only apply to highlighted text.

You can also add special characters from a selected font set by right-clicking while in in-place editing mode (or press CTRL+M) and selecting **Symbol Map** from the shortcut menu.

To exit the text editing mode, click outside the label or press ESC.

Note: When creating text labels, if you click *within* a layer and create your text label, the label becomes part of the layer. The text is attached to the layer frame. If you move or resize the layer, the default behavior is for the text label to move and resize in proportion to the layer frame's size and position.

If you click *outside* of any layer and create your text label, the label will *not* move or resize when the layer is moved or resized, unless you click and drag the label explicitly. Use independent labels (attached to the page) to create text -- like page titles -- that won't be moved.

To learn more about how the method of attachment affects text objects, see *Layer Association, Attachment Method and Scaling Considerations* on page 385.

To edit an existing text label

1. Double-click to enter the in-place editing mode.

To *temporarily* turn off the rotation when you in-place edit rotated labels:

1. Select **Tools:Options** to open the **Options** dialog box.
2. Select the **Text Fonts** tab.
3. Select the **Disable In-Place Editing** check box.
4. Click **OK**. When asked to save as a startup Option, say **No** (Say **Yes** to disable this option).

To add a background, a border or to center multi-line labels

Background and border characteristics, label rotation angle (also controllable graphically as described below), label transparency/opacity, font characteristics (also controllable via the **Format** and **Style** toolbar buttons), tab spacing, and multi-line centering are controllable via the **Text Control** dialog box.

1. Right-click on the text label and select **Properties** from the shortcut menu.

or

1. Press CTRL while double-clicking on the label.

To learn more, see *Reference: The Text Control Dialog Box* on page 394.

To resize a text label


1. Click once on the label.
2. Select the desired font size from the combo box on the **Format** toolbar.

or

2. Click the **Increase Font** or **Decrease Font** buttons   on the **Format** toolbar.

Note: You can also drag a control handle to resize a label. Select the label and drag and handle to resize.

To rotate a text label

1. Click twice (pause long enough between clicks to avoid a double-click). A locus of rotation symbol  displays in the middle of the label and round rotation handles display at the corners of the label.
2. Grab a rotation handle and rotate the label to the desired angle.

Note: You can specify a precise rotation angle in the **Text Control** dialog box.

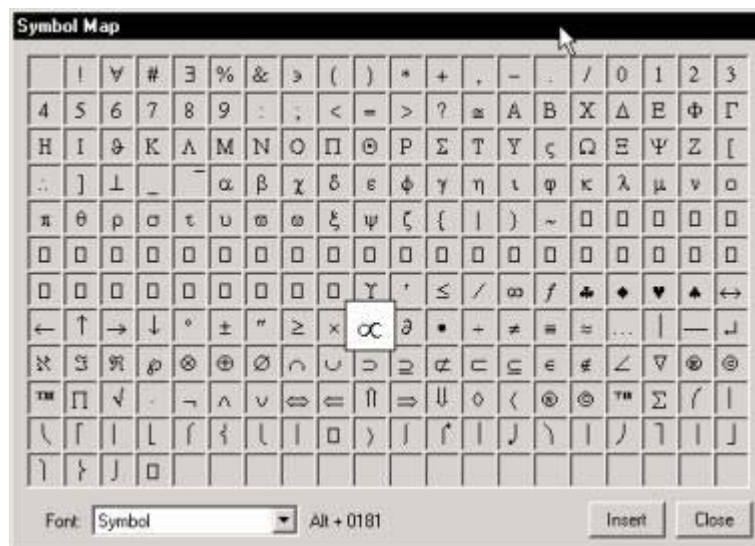
To disable second-click access to label rotation

1. Select **Tools:Options** to open the **Options** dialog box.
2. Select the **Text Fonts** tab and then select the **Simple Selection Mode** check box.

To add special characters to your text labels

To add special characters to your text labels:

1. Right-click and select **Symbol Map**.
2. Choose the **Font** that contains the special character from the drop-down list.



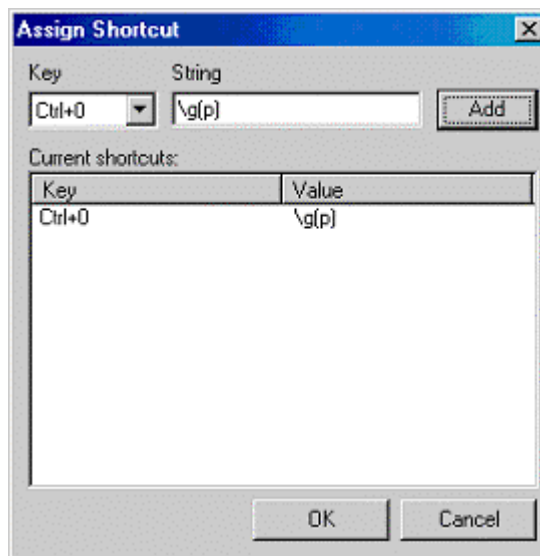
To create a special characters shortcut key combination

If you frequently use certain characters in your text labels, you can create shortcut keys for those characters. To do this:

1. Enter in-place editing mode and select the text that you intend to create when you invoke your shortcut key combination.
2. Right-click on the selected text and select **Assign Shortcut**. This opens the Assign Shortcut dialog box. The text you selected is entered into the **String** text box.
3. Select a shortcut from the **Key** drop-down list.
4. Click the **Add** button.

To create a shortcut for the Greek character π :

1. Click the **Text** tool and then click in your graph window. This starts the in-place editing mode.
2. Right-click and select **Symbol Map**.
3. Select π and click **Insert**.
4. Click **Close**.
5. Now highlight and right-click on the character.
6. Select **Assign Shortcut**.
7. Select a shortcut from the **Key** drop-down list.
8. Click **Add**.



9. Click **OK** to close the dialog box.

You can now use **CTRL+0** (in this example) as a shortcut for π when in-place editing.

Note: You can enter text directly into the **String** text box. However, if you do so, you must include any formatting syntax (i.e. \b(text) etc.).

To Remove a Shortcut

1. Re-open the **Assign Shortcut** dialog box.
2. Select the shortcut you want to remove from the **Current** list box.
3. Press DELETE.

Shortcut keyboard combinations for editing text labels


Control	Key Combination
Bold	CNTRL + B, CNTRL + SHIFT + B
Italic	CNTRL + I, CNTRL + SHIFT + I
Underline	CNTRL + U, CNTRL + SHIFT + U

Control	Key Combination
Greek	CNTRL + G, CNTRL + SHIFT + G
Strikeout	CNTRL + S, CNTRL + SHIFT + S
Superscript	CNTRL + SHIFT + =
Subscript	CNTRL + =
Supersubscript	CNTRL + -
Increase Font Size	CNTRL + SHIFT + >
Decrease Font Size	CNTRL + SHIFT + <
Select All	CNTRL + A, CNTRL + 5 (numpad)

To turn off in-place text editing


1. Select **Tools:Options** to open the **Options** dialog box.
2. Select the **Text Fonts** tab and then select the **Disable In-place Editing** check box.

When the in-place editing mode is disabled, double-clicking the label opens the **Text Control** dialog box.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Copying Labels via the Clipboard

To copy an object:

1. Click on the object to select it.
- or
1. Drag a box around the object with the **Pointer** tool . Selection handles will appear.
 2. From the menu, select **Edit:Copy**.
- or
2. Right-click on the object and select **Copy** from the shortcut menu.
- or
2. Press CTRL + C.

To paste the object into another window:

3. In the destination page, click once where you want the object to be pasted, then...
 4. From the menu, select **Edit:Paste**.
- or
4. Right-click and select **Paste** from the shortcut menu.
- or

4. Press CTRL + V.

Supported Escape Sequences

A Note about Displaying the Backslash Character in Text Labels

When you are creating/editing a text label using in-place methods, you can type the backslash character. It will not be interpreted as an escape sequence; in-place editing does not support escape sequences.

However, when you are entering text in the Text Control dialog box, using the backslash character can be problematic, as the Text Control dialog box interprets this as an escape sequence.

For example, if you type the following in a Text Control dialog box:

This file is located at C:\MY FILES

Origin displays:

This file is located at C:MY FILES

Note that the backslash doesn't display. If an unsupported option or no parenthesis follows the backslash character, then the backslash character is ignored and does not display.

One way to display a backslash character in your text labels is to type \\ in place of \. Origin will then display the second backslash. However, another way to display the backslash character is to use the \v() special formatting command.

For example, if you type the following in a Text Control dialog box:

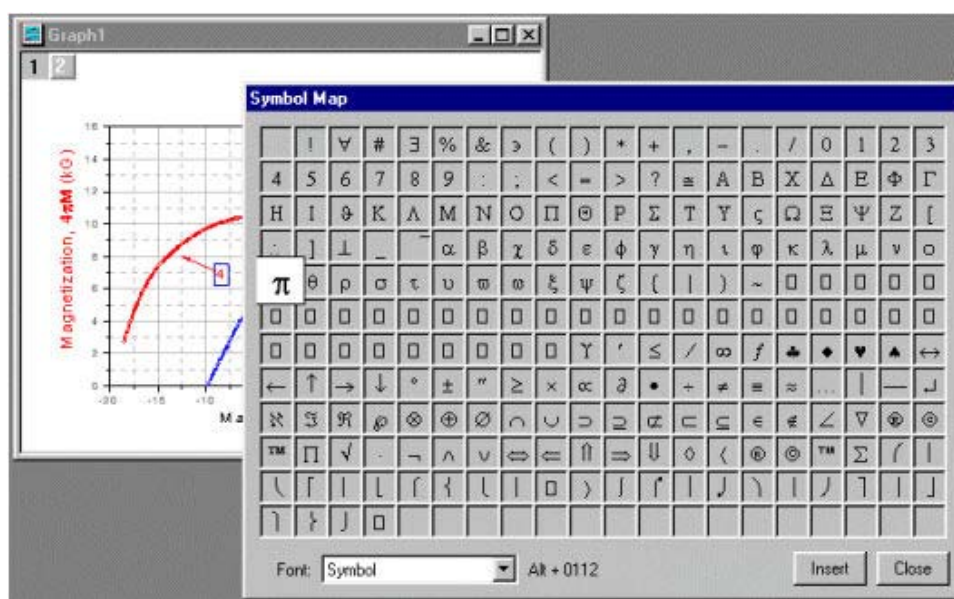
This file is located at \v(C:\MY FILES)

Origin displays:

This file is located at C:\MY FILES

Accessing the Extended Character Set

When you are editing a text label using Origin's "in-place" methods, you can add characters from a selected font set by right-clicking and selecting **Symbol Map** from the shortcut menu (or by pressing CTRL+M). This is the preferred method for entering special characters in a text label.




If you are entering text in the Text Control dialog box, in worksheet column cells that are designated as Label (columns), or you are typing prefixes or suffixes in text boxes (such as you see on the Tick Labels tab of the Axis dialog box), you can access the entire ANSI character set using [this procedure](#):

1. Click at the location in which you want to add the special character in the text box or worksheet cell.
2. Enable Num Lock (the light is on) on your keyboard.
3. Press and hold down the ALT key.
4. While holding down the ALT key, type **0**, followed by the **decimal code for the ANSI character** using the number keypad.
5. When you release the ALT key, the ANSI character displays (in the Text Control dialog box, it displays in the lower view box).

For the Text Control dialog box and prefix and suffix text boxes, Origin uses the font selected from the associated **Font** drop-down list to determine the character display in the label. If Arial is selected from the Font drop-down list, Origin uses the Arial character that corresponds to the code that you entered in the label.

If you want use a special character from a font set other than that selected from the Font drop-down list, you must add the appropriate embedded text formatting command around the special character. You will most have need for this when adding a special character from the Symbol set. In most cases, Symbol will not be selected from the Font drop-down list; instead your default label font will be selected. To instruct Origin to display the character associated with the code from the Symbol set, you must do one of the following:

- Add the **\g(SpecialCharacter)** embedded text formatting command.
- Highlight the special character and click the **Greek** button .

For text that you type in a worksheet column cell set to Label, Origin uses the font selected from the **Worksheet Display Control** dialog box.

Note: Each font has a unique ANSI character set. To find codes for characters from any font sets, consult the Windows Character Map (in the Accessories folder).

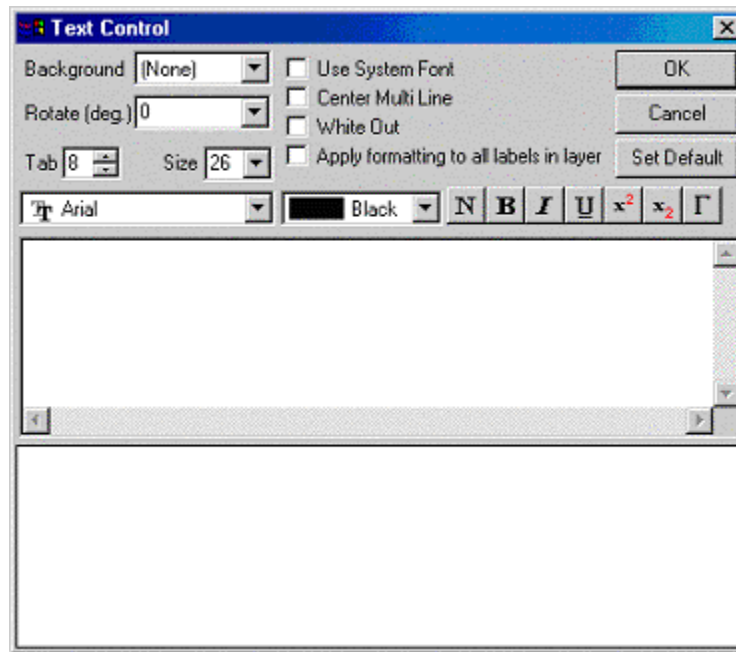
Reference: The Text Control Dialog Box

While in-place text editing methods have largely supplanted the need for the **Text Control** dialog box, it can still be used to edit and format text labels.

To open the **Text Control** dialog box:

1. Right-click on the text label and select **Properties** from the shortcut menu.
- or
1. Press CTRL while double-clicking on the label.

Text Control Dialog Box Controls



Note: You can use the scroll bars or resize this dialog box to enhance the text box view.

The **Background** Drop-down List



Select the desired text label background from this drop-down list. Select **None** to display the label without a background.

The **Rotate (deg)** Combination Box

To rotate the label, type or select the desired value from this combination box. Positive values rotate the label counterclockwise. Negative values rotate it clockwise.

The **Size (pts)** Combination Box

Type or select the desired font size (in points) from this combination box. The default point size is determined by the **Size** combination box value in the **Text Tool** group on the **Text Fonts** tab of the Options dialog box (**Tools:Options**).

Note: You can also quickly increase or decrease the font size of any selected text labels (CTRL select multiple labels) by clicking the **Increase Font**  or **Decrease Font**  buttons on the Format toolbar (**View:Toolbars**).

The **Font** Drop-down List

Select the desired font from this drop-down list. The default font selection is determined by the **Font** drop-down list in the **Text Tool** group on the **Text Fonts** tab of the **Options** dialog box.

Select **Default:FontName** to use the font determined by the **Default** drop-down list on the **Text Fonts** tab of the **Options** dialog box.

The Use System Font Check Box

Select the **Use System Font** check box to ignore the settings from the **Font** drop-down list and the **Size** combination box. Instead, use the system font. The system font provides faster redraw speed and enhanced screen legibility. However, when this check box is selected, text formatting (for example, italic, bold, and symbol) will not display.

The Center Multi Line Check Box

Select this check box to center the label text. This option is only useful for multi-line labels.

The White Out Check Box

To draw a separate white background for each line of text in the label, select the **White Out** check box.

The Apply Formatting to All Labels in Layer Check Box

Select this check box to apply the selection from the **Size** combination box and the **Font** and **Color** drop-down lists to all text labels in the layer.

The Color Drop-down List


Select the desired color from this drop-down list.

The Formatting Buttons and the (Upper) Text Box

Type the desired text in the text box in the middle of the dialog box. Press ENTER to start a new line. Press CTRL+TAB to insert a tab.

To format the text, use the text formatting buttons (Normal, Bold, Italic, Underline, Superscript, Subscript, and Greek Symbols) above the text box. Click-and-drag to highlight the desired text. Click on the desired formatting button to apply the format to the highlighted text. The formatting option displays in the text box as an embedded text formatting command. However, the lower view box provides a WYSIWYG display of the text.

If you click one of the formatting buttons without highlighting text first, Origin inserts the appropriate formatting commands at the current cursor location. Begin typing to add the text with the selected formatting.

Note: The **Normal** button  removes the formatting of the highlighted text.


The (Lower) View Box

The lower view box provides a WYSIWYG display of the text in the text box. If the layer that the text label is located in displays with a background color, the layer color displays in the view box.

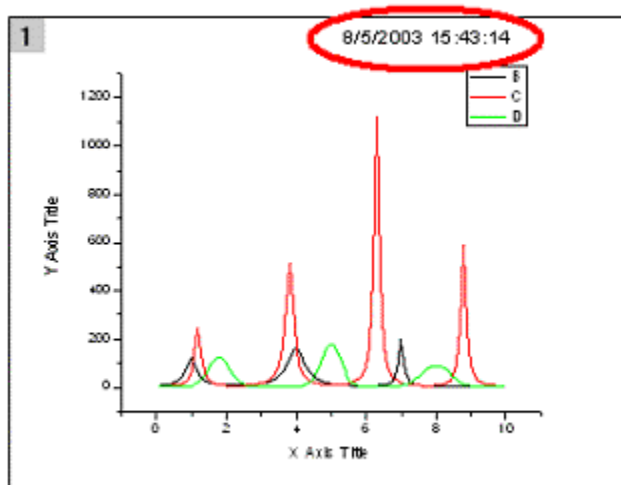
The Set Default Button

To set the current text settings as the default settings for future text labels in all graph windows in the project, click this button.

Adding a Date/Time Stamp to Your Graph

To add the current date and time to the top of your graph window, click the **Date & Time** button  on the Graph toolbar (**View:Toolbars**).

To delete the stamp, click on the stamp to select it and press DELETE.



To modify the Date/Time stamp:

1. Double-click on the stamp to enter text edit mode.
2. Edit or format the text label.

To modify the default format of the Date/Time stamp:

You must modify a line of LabTalk script. The Date & Time button runs a script in the [DateTime] section of the STANDARD.OGS file located in your Origin folder. That script consists of:

```
label -s -sa -d (.6*page.width) (.05*page.height) -n timestamp $(@D,D10);
```

The `$(@D,D10)` portion of this line of script specifies date/time format. In the default case, Origin displays the 10th (**D10**) date format (numbered from zero) from the Origin date format list (this format represented as M/D/YYYY HH:MM:SS).

To view the Origin date format list:

1. Double-click on any worksheet column to open the **Worksheet Column Format** dialog box.
2. Select **Date** from the **Display** drop-down list. Origin's date formats display in the **Format** drop-down list (numbered from zero).

When you know the index number of the date format that you want:

1. Open the file STANDARD.OGS in a text editor.
2. Locate the [DateTime] section.
3. Locate the line...

```
label -s -sa -d (.6*page.width) (.05*page.height) -n timestamp $(@D,D10);
```

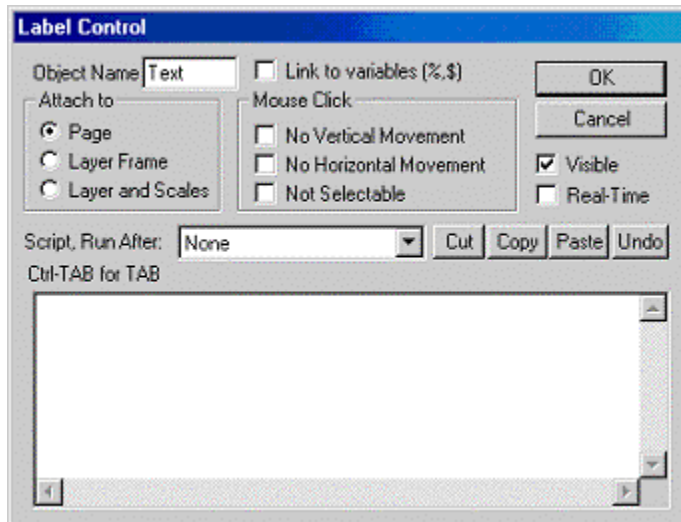
4. Change **D10** to **Dn**.
5. Save the modified OGS file.
6. Click the **Date & Time** button to display your modified format.

Reference: The Label Control Dialog Box

To open the **Label Control** dialog box:

1. Select an object (text label, line/arrow, etc.).
2. Right-click and select **Label Control** from the shortcut menu.

Label Control Dialog Box Controls



The Object Name Text Box

The label may be named, enabling Origin to identify the label during execution of built-in or user-defined programming scripts. Unnamed labels are not affected by any script other than entered in the object's Label Control dialog box.

Enter the desired name in the text box provided.

Warning: Some labels, such as the legend and the axis titles, are already named by Origin. In most cases, you will *not* want to rename legends and axis titles; doing so will cause menu commands that update the labels to no longer work, create a duplicate label, or over-write the modified label. On the other hand, renaming the legend is essential for preventing a customized legend from being overwritten when the graph window is refreshed. For more information, see [Changing the Legend Text](#) on page 410.

The Attach To Group

To control the effect of layer manipulation and axis rescaling on the label's size and position, select one of the following radio buttons:

Page. When attached to the page, the label is both position and scale independent of its layer. The label position and size are not affected by moving or resizing the layer, or by changing the axis scale. The label is still a part of the layer, however, and is deleted if the layer is deleted.

Layer Frame. When attached to the layer frame, the label is position dependent on its layer. When you move the layer, the label moves with the layer. If you resize the layer, the label changes dimensions proportionally and moves with the layer. If you rescale the axes, however, the label does not change size or position.

Layer and Scales. When attached to the layer and scales, the label is connected to the layer in terms of size and position. If you move the layer, the label moves with the layer. If you resize the layer, the label changes dimensions proportionally and moves with the layer. If you rescale the axes, the label size does not change, but the label moves so that it maintains the same XY coordinate value.

The **Link to Variables (%,\$)** Check Box

This check box is only useful in the Label Control dialog box of a text label. Select this check box if data or variables will display in the message displayed by the text label. Each time Origin redraws the label, the label is updated to reflect any changes made to the data or variables signified within.

When this check box is selected, proper notation conventions must be followed in the associated text label. Basic notation conventions are listed in Linking Text Labels to Data and Variables.

The **Mouse Click Group**

Select the **No Vertical Movement** check box to prevent movement of the label in the vertical direction.

When the **No Horizontal Movement** check box is selected, the label cannot be moved in the horizontal direction.

Select the **Not Selectable** check box to restrict selection or movement of the label entirely. This option is useful when using a label as a backdrop to a page or layer. When Not Selectable is selected, you cannot use the ALT+double-click shortcut to edit the dialog box. Instead, enter **Button Edit Mode (Edit:Button Edit Mode)**, click on the label, and select **Format:Label Control**.

The **Visible** Check Box

When the **Visible** check box is selected, the label's associated Text Control dialog box, as well as the Label Control dialog box, are accessible by double-clicking on the label (Text Control), or ALT+double-clicking on the label (Label Control). The label can also be moved and resized.

When this check box is cleared, the label is *not* visible and its associated dialog boxes cannot be accessed by double-clicking (or ALT+double-clicking) on the label.

To display and edit the label, enter Button Edit Mode by selecting **Edit:Button Edit Mode**. Exit Button Edit Mode after editing the label by re-selecting **Edit:Button Edit Mode** (When in Button Edit Mode, the **Button Edit Mode** menu command has a check mark next to it).

The **Real-Time** Check Box

Select the **Real-Time** check box to update the label in real-time whenever there is a real-time plotting event.

The **Script, Run After** Drop-down List

The option selected from this drop-down list defines the circumstances required for script execution. Enter the script to be executed in the associated text box beneath this drop-down list.

Option	Script Execution Method
None	Do not execute script.
Button Up	Execute script when button is clicked.
Moved	Execute script when button is moved.
Sized	Execute script when button is resized.
Moved or Sized	Execute script when button is moved or resized.
Redrawn	Execute script when button is redrawn.
Real-Time	Execute script when a real-time event occurs. These events are typically generated through DDE data transfer or from a Data Acquisition module.

Option	Script Execution Method
Window Create	Execute script when the button's window first opens.
Window Close	Execute script when the button's window closes.
Window Activate	Execute script when the button's window becomes active.
Window Deactivate	Execute script when the button's window becomes inactive.
New Selection	Execute script when unselected button is clicked.
Before Save	Execute script immediately before saving the project.
Axes Rescale	Execute script when graph axes rescale.
All Events	Execute script when any one of the previous events occur.

The (Script) Text Box

To associate a script with an object, type the script directly in this text box or copy and paste it from any text editor.

Each LabTalk statement in the script must end with a semicolon.



ENTER is a simple carriage return.

To add a tab within the text box, use CTRL + TAB.

Drawing Objects



Drawing Lines and Arrows

- To add a straight line or arrow to the graph:


- Click on the **Line** tool  or **Arrow** tool  (on the Tools toolbar).
- Click-and-drag at the desired location in the graph window. Release the mouse button and the line (or arrow) is displayed.

You can add or remove arrow heads from lines and arrows by double-clicking on the line or arrow. This opens the **Object Properties** dialog box. Select the **Arrow** tab to access controls for the **Begin** and **End** arrow head(s).

- To draw a vertical or horizontal line or arrow:

- Press the SHIFT key as you drag with the **Line** tool  or **Arrow** tool .

- To add a *curved* arrow to the graph:

- Click on the **Curved Arrow** tool  (on the Tools toolbar).
- Click in four places along the intended arc to locate the curved line's anchor points; place the first click at the beginning of the curve, the second two clicks along the

curve, and the final click at the point where you want the arrow head. After the fourth click, Origin displays the curved arrow. The points are connected with a Bezier curve.

To remove the arrow head from the Bezier curve:

1. Double-click on the arrow. This opens the **Object Properties** dialog box.
2. Select the **Arrow** tab to access controls for the arrow head display.


- To draw a polyline:

1. Click on the **Polyline** tool (on the Tools toolbar), then click once at each intended anchor point.

To end the line:

2. Either double-click at the last point location or click once and then press ESC.

- To draw a freehand line:


1. Click on the **Freehand Draw** tool .
2. Click once and hold while dragging out your line.
3. Release the mouse button to complete the operation.

- To copy an object from one window to another:

To copy an object:

1. Click on the object to select it.

or

1. Drag a box around the object with the **Pointer** tool .

Selection handles will appear.

2. From the menu, select **Edit:Copy**.

or

2. Right-click on the object and select **Copy** from the shortcut menu.

or

2. Press CTRL + C.

To paste the object into another window:

3. In the destination page, click once where you want the object to be pasted, then...

4. From the menu, select **Edit:Paste**.

or

4. Right-click and select **Paste** from the shortcut menu.

or

4. Press CTRL + V.

Drawing Boxes, Circles, Polygons, and Regions






To add a rectangle, circle, ellipse, polygon, or region to the graph, click the respective button on the **Tools** toolbar:



- For all objects but the polygon, click-and-drag at the desired location in the graph window. Release the mouse button to display the object.
- For polygons, click in the window at each of the corner locations for the polygon. Either double-click at the last location or click once and then press ESC.

Editing Objects


An Origin drawing object has multiple editing modes. These modes are sequentially activated by clicking on the object *in a slow, deliberate manner* (pause about 1 second between mouse clicks).

Objects created with the **Polygon** , **Region** , **Polyline** , **Freehand Draw** , or **Curved Arrow**  tools have *four* edit modes:

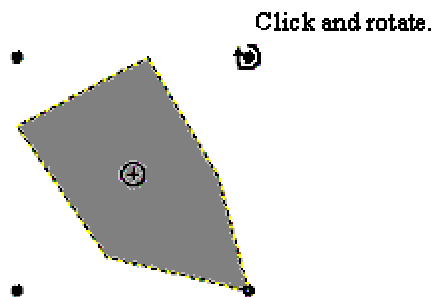
- resize (square selection handles at corners and sides).

To resize, click once. Square handles will appear at the corners and sides of the object.

- rotate (round handles).

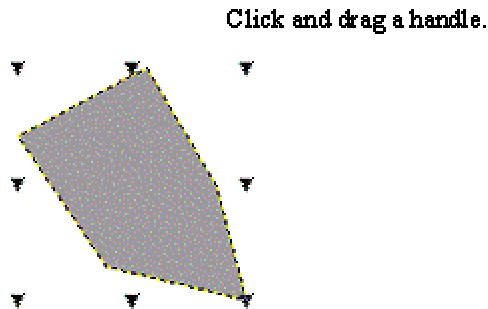
To rotate an object, click twice in a slow deliberate fashion. A moveable locus of rotation  appears in the middle of the object. Round rotation handles display at the corners of the object.

Drag a corner handle to rotate the object. Reposition the locus to change the point about which the object rotates.



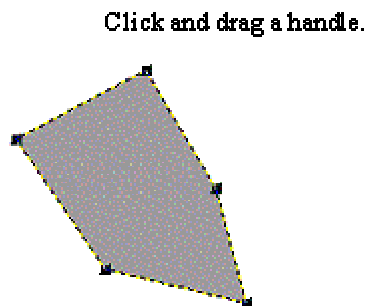
- skew (arrowhead-shaped handles).




To skew an object, *click three times in a slow deliberate fashion*. Triangular skew handles display at the corners of the object. Click on a skew handle and drag the object to the desired shape.




- edit or point-by-point reshaping (square-shaped handles).

To move points in an object, *click four times* in a slow, deliberate manner. Handles appear at moveable, shape-defining points. To alter object shape, drag points to new locations .



Objects created with the **Rectangle** , **Circle** , **Arrow**, or **Line**  tools only have resize, rotate and skew edit modes; they *do not* have a point-by-point reshaping mode.

Additional object controls are available from the **Object Properties** dialog box.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

The Object Properties Dialog Box

To open the **Object Properties** dialog box:

1. Select an object, right-click and choose **Properties** from the shortcut menu.

or

1. Double-click on the object.

The Object Properties Dialog Box (*see individual tab controls for figures*)

Note that tab (and control) availability is object type (text object, arrow object, etc.) dependent.

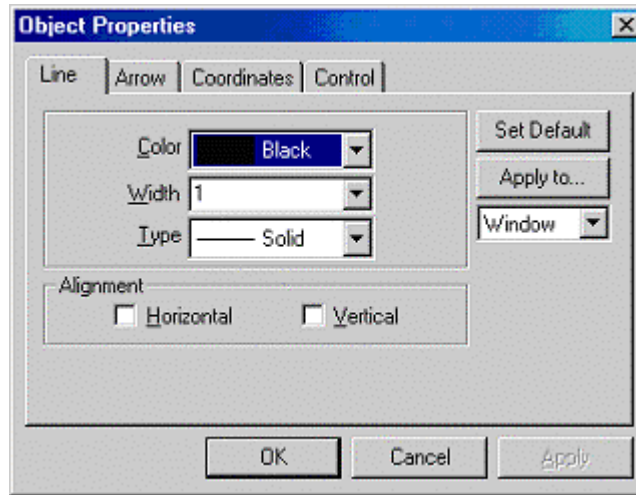
The Set Default Button

Applies tab settings (for example, the **Line** tab) to the currently selected object and to all future objects of the same type.

The Apply To Button

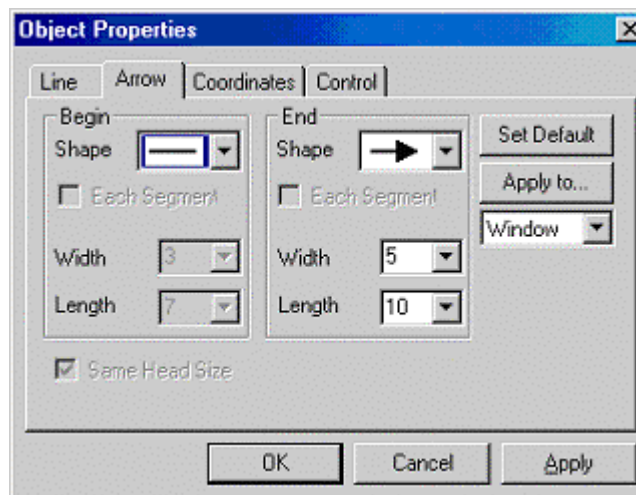
To apply your tab settings to all objects of the same type (line, arrow, polyline, etc.) that are currently in the layer or window, (1) make a selection from the **Apply To** drop-down list and (2) click **Apply To**.

The Line Tab



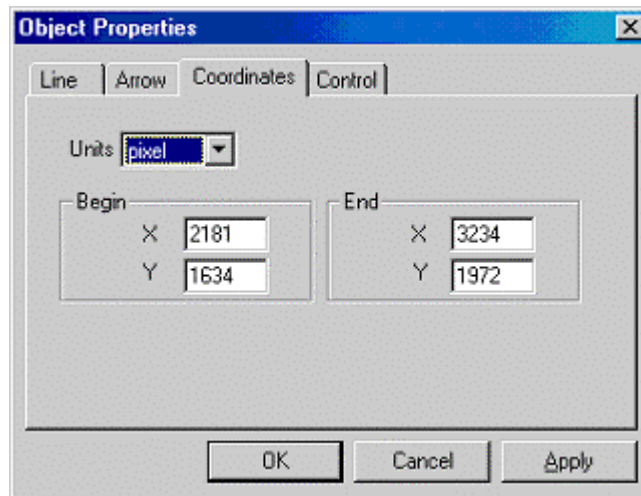
Edit this tab to control the color, line thickness, and line type. You can also set the alignment to vertical or horizontal.

The Arrow Tab



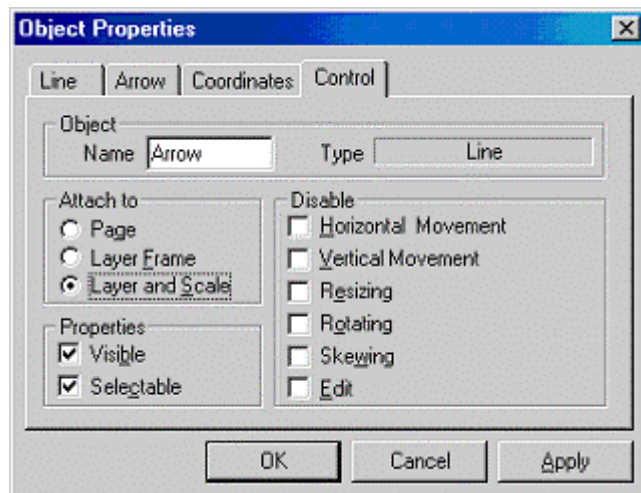
Edit this tab to control the display of the begin and end arrow heads. If both a begin and end arrow head is selected, you can select the **Same Head Size** check box to ensure that changes you make to the width or length of the arrow head in either the **Begin** or **End** group apply to both.

The Coordinates Tab



Specify the begin and end coordinates for the line or arrow using the units selected from the **Units** drop-down list.

The Control Tab



The **Object** Group

This group displays the object's current name. Origin names objects by starting with a default base name (for example, Line), and incrementing the name. You can edit this name.

Label names can be used in LabTalk script to programmatically control the object.

The **Attach To** Group

To control the effect of layer manipulation and axis rescaling on the object's size and position, select one of the following radio buttons:

- **Page.** When attached to the page, the object is both position and scale independent of its layer. The object position and size are not affected by moving or resizing the layer, or by changing the axis scale. The object is still a part of the layer, however, and is deleted if the layer is deleted.

- **Layer Frame.** When attached to the layer frame, the object is position dependent on its layer. When you move the layer, the object moves with the layer. If you resize the layer, the object changes dimensions proportionally and moves with the layer. If you rescale the axes, however, the object does not change size or position.
- **Layer and Scale.** When attached to the layer and scales, the object is connected to the layer in terms of size and position. If you move the layer, the object moves with the layer. If you resize the layer, the object changes dimensions proportionally and moves with the layer. If you rescale the axes, the object size does not change, but the object moves so that it maintains the same XY coordinate value.

The **Properties** Group

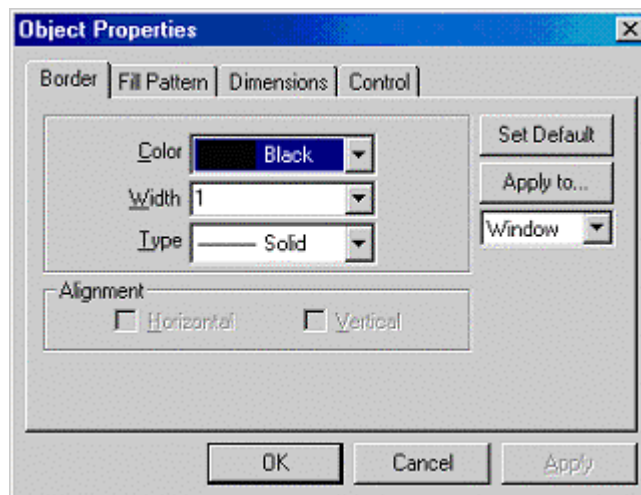
- **Visible.** When this box is selected, the object is visible and selectable. When this check box is cleared, the object is not visible and not selectable. To display and edit the label, enter Button Edit Mode by selecting **Edit:Button Edit Mode**. Exit Button Edit Mode by re-selecting **Edit:Button Edit Mode**.
- **Selectable.** When this box is selected, the object can be selected (and edited). When the check box is cleared, the object is non-editable. To edit the label, enter Button Edit Mode by selecting **Edit:Button Edit Mode**. Exit Button Edit Mode by re-selecting **Edit:Button Edit Mode**.

The **Disable** Group

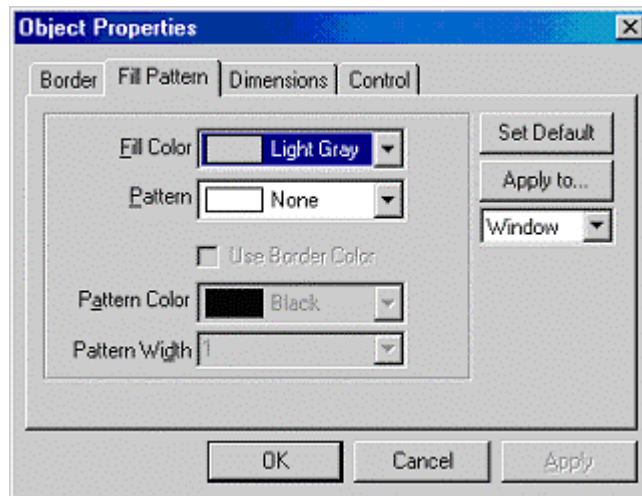
This group's options control the shape and position of an object.

- **Horizontal Movement.** Select this box to prevent horizontal movement.
- **Vertical Movement.** Select this box to prevent vertical movement.
- **Resizing.** Select this box to prevent resizing.
- **Rotating.** Select this box to prevent rotation.
- **Skewing.** Select this box to prevent skewing.
- **Edit.** Select this box to prevent point-by-point reshaping.

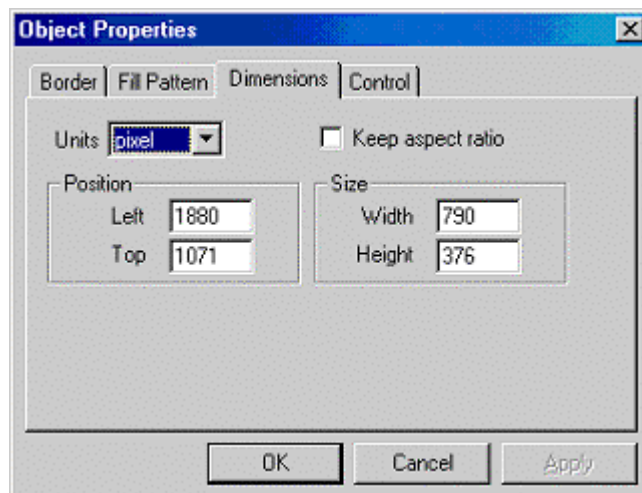
The **Border** Tab



Specify the border display properties from this tab.

The Fill Pattern Tab

Specify the fill color and pattern from this tab.


The Dimensions Tab

Specify the top and left object position in units selected from the **Units** drop-down list.

Select the **Keep Aspect Ratio** check box to only allow proportional sizing.

Arranging and Aligning Objects

Creating Vertical or Horizontal Lines at Specific X or Y Values

There are a couple of ways to draw vertical or horizontal lines at specific X or Y values. The simplest method is to press the SHIFT key while you draw a line with the **Line** tool  (the SHIFT key causes the line to snap to vertical or horizontal), then drag the line to the desired location.

For more accurate placement, you can:

- Double click on the line, select the **Coordinates** tab and use the **Units** drop down and **Begin** and **End** text boxes to position the line.

- Name the line in the line's **Object Properties** dialog box (double-click on the object) and then assign an X or Y position using LabTalk script.

For example, if you create a line, align it vertically, and then name the line **MyLine** in the line's Object Properties dialog box, you can type the following text in the Script window (**Window:Script Window**) to move the line to X=5.

myline.x=5 (ENTER)

One disadvantage of using this technique to draw a line at a specific X or Y location is the rough control you have over the length of the line. Alternatively, you can use the LabTalk **Draw** command to create a vertical (or horizontal) line that is the length of the layer and is located at a specific X (or Y) axis value:

draw -l -v XAxisValue

draw -l -h YAxisValue

For example, to create a vertical line the length of the layer at X=5, type the following text in the Script window:

draw -l -v 5 (ENTER)

You can edit or format this line as you would any other line object.

To create multiple vertical or horizontal lines:

If you require multiple vertical or horizontal lines in your graph, you can perform the previous steps multiple times. Alternatively, you can display multiple lines by creating a new data set which contains XY pairs at the locations that you require vertical or horizontal lines. You can then add this data to your graph layer as a scatter graph, and then use the LabTalk **Set** command to display vertical lines for each XY pair. The syntax for this script is:

set Worksheet_ColumnName -k 58

For example, if columns A(X) and B(Y) of the Data2 worksheet contain the XY pairs for your vertical lines and are plotted in your graph as a scatter graph, type the following text in the Script window:

set data2_b -k 58 (ENTER)

Note1: If an object is attached to **Layer and Scales** and you **Zoom In** on a portion of the graph, the object may extend beyond the graph's layer frame. To prevent this, make sure that the object is attached to the Layer Frame. For more information on object attachment options, see the discussion of the **Attach To** group in the topic *Associating LabTalk Script with an Object* on page 423, and *Controlling the Display and Scaling of the Objects in a Layer*, on page 309.

Note2: In addition to displaying vertical or horizontal lines in your graph, you can enable the display of vertical or horizontal drop lines for any data point in a data plot that includes symbols. Press CTRL while double-clicking on a data point, then edit the (**Plot Details**) **Drop Lines** tab.



Vertical or Horizontal Alignment of Existing Lines

To align lines or arrows vertically or horizontally, do one of the following operations:

- Double-click on the object to open the **Object Properties** dialog box. Select the **Line** tab and select the **Horizontal** or **Vertical** check boxes.
- Click once on the existing line or arrow to select it. Press the SHIFT key and at the same time, drag the control handle of the end that you want to move.



The line or arrow will snap horizontally or vertically (to which ever alignment requires the least angular movement).

- Select the desired objects (press SHIFT to select multiple objects) and click either the **Vertical Alignment** button  or the **Horizontal Alignment** button  on the Arrow toolbar (View:Toolbars).


Aligning Objects

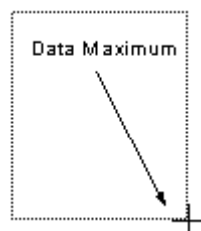
Origin provides two tools for aligning objects on the page:

- The alignment tools on the **Object Edit** toolbar.

The **Object Edit** toolbar contains buttons that provide for easy arrangement of *preselected* objects.



- Click on the desired object to select it.
- To select multiple objects, SHIFT + click on the desired objects or drag a box around the target objects using the **Pointer** tool .



When you select multiple objects and click one of the alignment buttons, Origin aligns the objects with respect to the *first* selected object.

- Snapping objects to a grid.

Origin provides an object grid that facilitates object alignment in the window. To view the object grid, select **View:Show:Object Grid**. A check mark appears next to the menu command when the grid is active.


Objects on the page of the window are automatically aligned with the grid by selecting **Format:Snap Object to Grid**. A check mark appears next to the menu command when Snap Object to Grid is enabled.

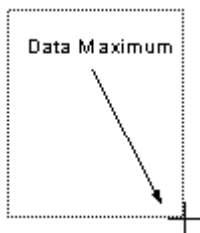
Objects which are added to the page after selection of this menu command automatically align with the nearest grid upon placement.


Objects which are already located on the page align with the nearest grid when the object is moved.

Grouping Objects


To group multiple objects in a window:

1. To select multiple objects, SHIFT + click on the target objects or drag a box around the objects using the **Pointer** tool .





2. Click the **Group** button  on the Object Edit toolbar to group the objects.

You can now drag the group of objects to a new location, or align the group of objects with other objects on the page.

To ungroup the objects, select the grouped object and click the **Ungroup** button  on the Object Edit toolbar.

Moving Objects to the Front or the Back

If your graph includes text labels or other annotations that overlap, you can move selected objects to the front or the back of the display. To move objects to the foreground or background:

1. Select the object(s) that you want to move to the front or back.
2. Click the **Front** button  or the **Back** button  on the Object Edit toolbar (**View:Toolbars**).

Legends and Color Scales

Creating and Updating a Legend

The legend is automatically created when you plot worksheet data. When additional data sets are added to the layer, the legend is not automatically updated to include the new data sets unless the **Auto Update** check box is selected on the **Legends** tab of the page's Plot Details dialog box (**Format:Page**).

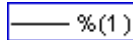
A new legend can be created at any time by selecting **Graph:New Legend** or by right-clicking in the layer and selecting **New Legend** from the shortcut menu. This menu command adds a legend to the *active* layer. If a legend already exists in the layer, the menu command *updates* the legend to reflect the current data displayed in the layer.

Changing the Legend Text

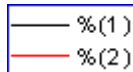
A legend is a specialized Origin text label. Origin names the text label "Legend" to uniquely identify it. This name is stored in the legend's **Label Control** dialog box. You can open this dialog box by selecting the legend and then selecting **Format:Label Control**. *If you rename the legend*, it becomes a static object; it will maintain its current contents but it will no longer update when you click **New Legend** or when you

add data to the layer. If you customize the legend text according to procedures outlined below, you will need to rename the legend in the Label Control dialog box.

A legend text label uses special formatting to display the data set names and the data plot type icon (such as a line). If you double-click on the legend text and enter text editing mode, the legend text will look something like this (in this example, one data plot is in the layer):



The %(1) is an example of substitution notation. This notation instructs Origin to display the data set name for the *first* data set in this layer (If there were two data plots in the layer, the in-place editing mode would look like this):



When you are in this text-edit mode, you can simply overwrite this %(DataListPosition) notation with whatever text you prefer to display. However, you can also manipulate the substitution notation system that Origin uses -- whether editing the legend or any other text label -- to alter the text in the legend (for example).

You could, for example display the value of a specific data point in a data plot using the following substitution notation:

%(WorksheetName, ColumnNumber, RowNumber)

For example, if a worksheet is named Data1, and you have plotted columns A(X) and B(Y), you could opt to display the value of the data point in column 2, row 3 using this expression:

%(data1, 2, 3)

To learn more, see *Linking Text Labels to Data and Variables* on page 421.

Possibilities:

- To alter the text that displays in the legend, you can add these special @letter arguments using a %(DataListPosition,@letter) notation.

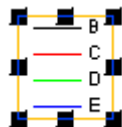
Use this @letter argument...	...to display this text in the legend
@d	Primary data set name.
@c	Column name.
@w	Worksheet name.
@wl	Worksheet label.
@l	All lines of column label on separate lines.
@u	First two lines of column label on same line, second label enclosed in parentheses.

Note that to use substitution notation, you must select the **Link to Variables (%,\$)** check box in the Label Control dialog box (this is done by default, when the legend is created).

- To control the display of the data plot icon in the legend, use a special escape sequence.

Since escape sequences are not supported by Origin's normal, in-place text editing mode, you must use the Text Control dialog box for this. To open the legend's Text Control dialog box:

- Click on the legend to select it.

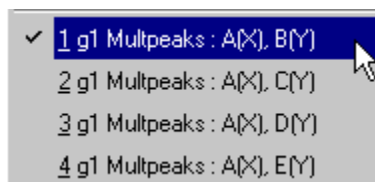


2. Right-click and select **Properties** from the shortcut menu.

With the Text Control dialog box, the general syntax for the legend display is:

`\L(DataListPosition) %(DataListPosition)`

Where **DataListPosition** is the data plot's position in the data list, the list of plotted data at the bottom of the **Data** menu. The `\L()` switch creates the data plot type representation. The "\" indicates to Origin that this is to be treated as an embedded text formatting command. The "L" tells Origin to form the data plot type icon. The number in parentheses is the data set's position in the data list (at the bottom of the **Data** menu, when the graph is active).



Origin determines the current graph type (line, scatter, etc.) for the data plot at the specified position, and displays the appropriate data plot type icon.

Use of the `%(DataListPosition)` notation in the Text Control dialog box is as described above.

Another option for customizing the legend is to edit the Origin initialization file that defines what the legend will display.

Origin creates graph legends based on the **legend** variable setting in the [Text] section of the ORIGIN.INI file (located in your Origin folder). In the ORIGIN.INI file, **legend**=`\L(%d) %%(%d)\r\n`, where the string is in C printf format. This notation can be summarized as follows:

`\L(%d)` creates a data plot type icon for each data plot in the data list.

`%%(%d)` creates the text entry for each data plot type icon.

`\r\n` creates a new line between legend entries.

In the second part of this expression, the **@letter** notation has been omitted:

`%%(%d,@letter)`

When **@letter** is omitted, Origin assumes **@u**. **@u** tells Origin to take the first two lines from the column label field and display them in a single line in the graph legend:

first line (second line)

If no labels exist, Origin displays the column name in the legend by default.

You can customize your legends by modifying the **legend** assignment statement in the ORIGIN.INI file. You can use any of the **@letter** arguments reviewed above. One advantage for customizing the legend by editing the **legend** variable is that Origin will not overwrite your custom legend. However, if the Full Dataset Name check box on the Legend tab of the Plot Details dialog box (graph page icon selected on left side of dialog box) is selected, Origin will

always display the data set name in the legend, independent of the *@letter* specification in the ORIGIN.INI file.

Displaying Data Plots from Different Layers in One Legend

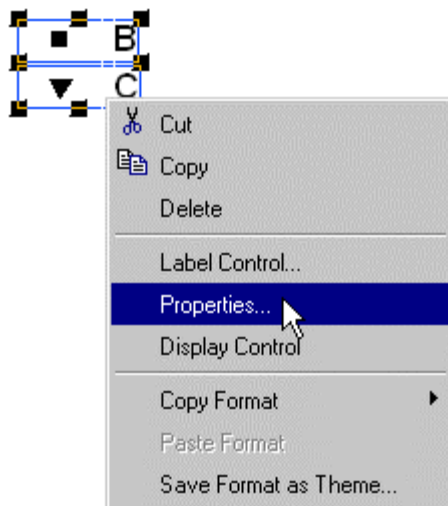
The default legend displays the data plot type icons and column names of the data plots displayed in the associated layer. When you are creating a graph with *multiple* layers, you may observe that a separate legend is created for each layer. If you so desire, you can display the data plot type icons and column names of data sets from any, or all, of the layers in the graph window together in a single legend. There are two methods for doing this:

Automatic Method of Including Data Plots from All Layers in a Single Legend:

1. From the menu, choose **Format:Page**. This opens the **Plot Details** dialog box at the page level.
2. Select the **Legends** tab.
3. Select the **Include Data Plots from All Layers** check box and click **OK** or **Apply**.

Data sets from all plots in the graph are combined into a single legend. Note that re-saving the graph template at this point will save the **Include Data Plots from All Layers** setting as the *default* setting for the template.

Note: To add a background or border to the legend, select the entire legend, right-click and choose **Properties** from the shortcut menu.



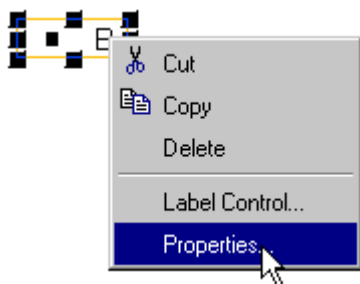
Manual Method of Including Data Plots from All Layers in a Single Legend:

This method predates the Automatic method and is included primarily for informational purposes or for those who wish to have further control over the legend display.

To use this method you must open the legend's **Text Control** dialog box, as Origin does not support using the necessary escape sequences in the in-place editing mode.

To open a legend's Text Control dialog box:

1. Select the legend object, right-click and choose **Properties** from the shortcut menu.



This opens the **Text Control** dialog box. Use the following syntax to manually create a legend that includes data sets from other layers:

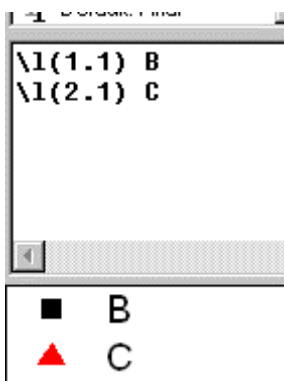
$\backslash L(\text{LayerNumber}.\text{DataPlotNumber},\text{DataPointNumber}) \text{ DataPlotName}$

LayerNumber is the layer number displaying the data plot. If *LayerNumber* is not specified, the legend layer is the default (the layer which includes the legend).

DataPlotNumber is the position of the data plot in the data list (when the respective layer is active).

DataPointNumber is the row or index number of the data point in the data set (mostly of interest when you have modified the plot characteristics of a single data point).

When using the **$\backslash L(\text{LayerNumber}.\text{DataPlotNumber},\text{DataPointNumber})$** notation to create a legend from multiple layers, you *cannot* use the **%()** notation to create the data plot *names* for the legend. Enter the appropriate name after the **$\backslash L()$** command in the text box of the Text Control dialog box.



Adding an Individual Data Point to the Legend

Individual data points can be added to the legend. This is useful when you have modified the display properties of a single data point in your plot.

To add an individual data point to the legend, you must edit the legend's **Text Control** dialog box as Origin's normal, in-place text editing methods do not support the necessary escape sequences.

To open a legend's Text Control dialog box:

1. Right-click on the label and select **Properties** from the shortcut menu.
2. Use the following syntax to add the layer, data plot and data point number to the text box.

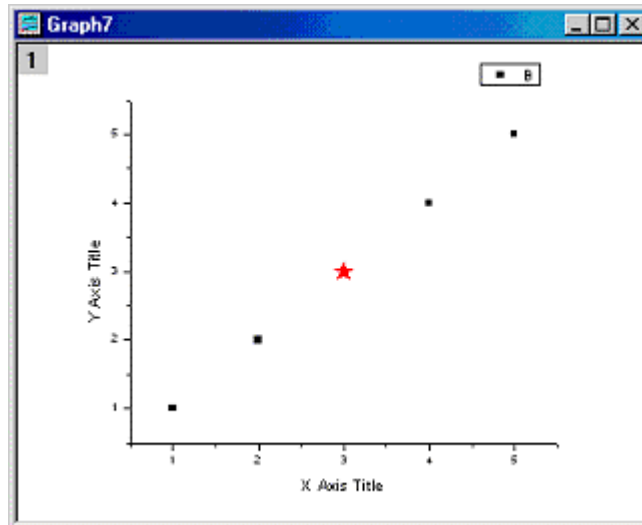
$\backslash L(\text{LayerNumber}.\text{DataPlotNumber},\text{DataPointNumber})$

where

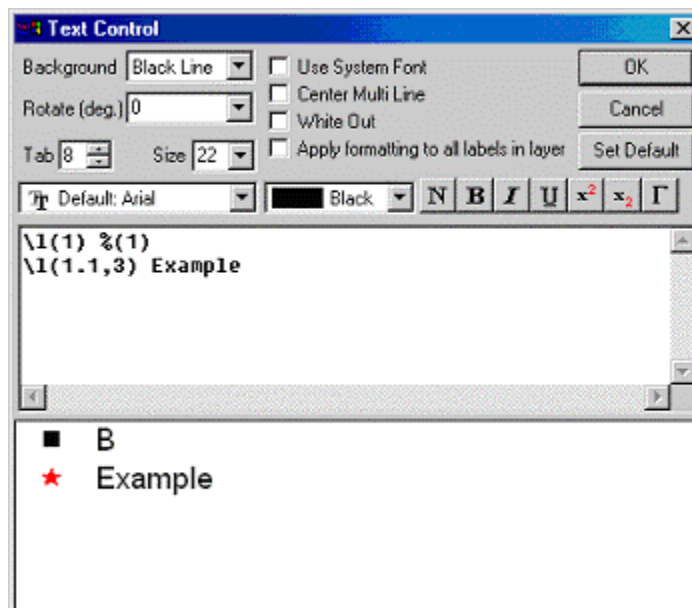
- *LayerNumber* is the layer number displaying the data plot. If a *LayerNumber* is not specified, the legend layer is the default.
- *DataPlotNumber* is the position of the data plot in the data list (when the respective layer is active).
- *DataPointNumber* is the row or index number of the data point in the data plot.

For example:

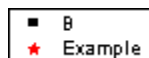
To add the customized data point in this graph to the legend, you would:



1. Select the legend, right-click and choose **Properties**.
2. Enter the second line of text as it appears in the figure below.



3. The resulting legend looks like this:



How to Have Complete Control Over the Legend Display

A graph legend can be created displaying data plot icons that are completely independent of the displayed plot details. Origin allows for complete control over the data plot icons in the legend by using the following syntax in the text box of the legend's Text Control dialog box (to open this dialog box, right-click on the label and select **Properties** from the shortcut menu).

`\L(O(SymEdgeColor,Sym,Fill,Size,ColorLn,LineStyle,Gap,LnWidth,SymFillColor))`

where:

SymEdgeColor determines the color of the symbol edge in the legend. Type a value corresponding to the color sequence in the color palette (1=Black, 2=Red, etc.). To view the complete color sequence, select **Format:Color Palette**.

Sym determines the symbol shape in the legend. Type a value corresponding to the symbol shape, where 0 = no symbol, 1 = square, 2 = circle, 3 = up triangle, 4 = down triangle, 5 = diamond, 6 = cross (+), 7 = cross (x), 8 = star (*), 9 = bar (-), 10 = bar (|), 11 = *number*, 12 = *LETTER*, 13 = *letter*, 14 = right arrow, 15 = left triangle, 16 = right triangle, 17 = hexagon, 18 = star, 19 = pentagon, and 20 = sphere.

Fill determines the symbol interior for the symbols in the legend. Type a value corresponding to the symbol interior, where 0 = solid, 1 = open, 2 = dot center, 3 = hollow, 4 = + center, 5 = x center, 6 = - center, 7 = | center, 8 = half up, 9 = half right, 10 = half down, and 11 = half left.

Size determines the symbol size in the legend. Type a value for the symbol size in points.

ColorLn determines the line color in the legend. Type a value corresponding to the color sequence in the color palette (1=Black, 2=Red, etc.). To view the complete color sequence, select **Format:Color Palette**.

LineStyle determines the line style for the legend. Type a value corresponding to the line style sequence in the Style drop-down list on the Line tab of the Plot Details dialog box (0=Solid, 1=Dash, etc.).

Gap determines the line and symbol gap in the legend. Type a gap value that corresponds to a % of the symbol diameter. For example, type **50** to display a gap between the symbol and the line (in the legend) which is 50% of the symbol diameter.

LnWidth determines the line width for the legend. Type a value for the line width in points. A value of 0 results in no line display.

SymFillColor determines the color of the symbol fill in the legend. Type a value corresponding to the color sequence in the color palette (1=Black, 2=Red, etc.). To view the complete color sequence, select **Format:Color Palette**.

See also, *Customizing the Legend for Categorical Data Plots 416*.

Customizing the Legend for Categorical Data Plots

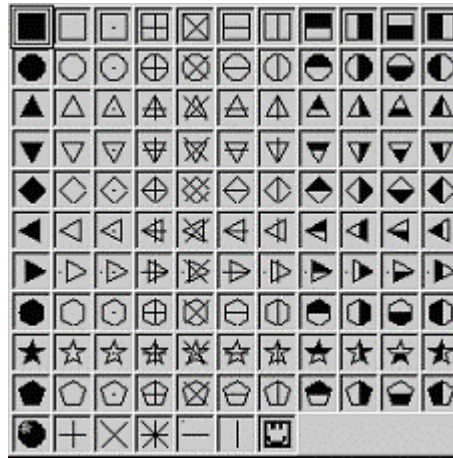
Customize the legend via the text box of the legend's **Text Control** dialog box. To open this dialog box:

1. Right-click on the legend text.
2. Select **Properties** from the shortcut menu.

Use the following syntax:

`\L(S(Category, arg2, arg3, arg4, arg5, arg6, LineStyle, LineColor, LineWidth, Gap))`

- To use a geometric symbol from the Origin symbol gallery, enter *Category* = 0, then enter these values:



arg2 (symbol shape) =

0 = no symbol, 1 = square, 2 = circle, 3 = up triangle, 4 = down triangle, 5 = diamond, 6 = cross (+), 7 = cross (x), 8 = star (*), 9 = bar (-), 10 = bar (|), 11 = *number*, 12 = *LETTER*, 13 = *letter*, 14 = right arrow, 15 = left triangle, 16 = right triangle, 17 = hexagon, 18 = star, 19 = pentagon, 20 = sphere.

arg3 (fill type) =

0 = solid, 1 = open, 2 = dot center, 3 = hollow, 4 = + center, 5 = x center, 6 = - center, 7 = | center, 8 = half up, 9 = half right, 10 = half down, and 11 = half left.

arg4 (symbol edge color) =

1=black, 2=red, etc. Values correspond to the sequence in your Origin color palette. To determine this sequence, select **Format:Color Palette** from the Origin menu.

arg5 (symbol fill color) =

1=black, 2=red, etc. Values correspond to the sequence in your Origin color palette. To determine this sequence, select **Format:Color Palette** from the Origin menu.

arg6 (symbol point size) =

Enter a point size value for the symbol.

LineStyle =

0 = no line, 1 = solid, 2 = dash, 3 = dot, 4 = dash dot, 5 = dash dot dot, 6 = short dash, 7 = short dot, 8 = short dash dot

LineColor =

1=black, 2=red, etc. Values correspond to the sequence in your Origin color palette. To determine this sequence, select **Format:Color Palette** from the Origin menu.

LineWidth =

Enter a point value for the line width. 0 = no line.

Gap =

Determines the legend's line to symbol gap (line & symbol plots). Value is a % of the symbol diameter. (e.g. **50** will insert a gap that is 50% of symbol point size).

- To use an ASCII character or a user-defined symbol, enter *Category* = 1, then enter these values:

arg2 (symbol/char index) =

- For user-defined symbols, enter *arg2* = 1 - 31. Value corresponds to the order in the **User Defined Symbols** grid on the Graph tab of the Options dialog box (**Tools:Options**) (i.e., to use the first symbol in the grid enter *arg2* = 1; order in symbols grid is left to right, top to bottom).
- For ASCII characters, enter *arg2* = 32 - 255. Value is the ASCII code for the character.

arg3 (symbol/char color) =

1=black, 2=red, etc. Values correspond to the sequence in your Origin color palette. To determine this sequence, select **Format:Color Palette** from the Origin menu.


arg4 (symbol point size) =

Enter a point size value for the symbol.

arg5 (font) =

Used only for characters. This is the index number of a particular font in your font list.

To obtain this value, do the following:

- Click the **Script Window**  button.
- Type the following into the script window and press ENTER:

```
font ( fontname ) =
```

Origin responds with the font list index number for *fontname*.

arg6 (font style) =

Used only for characters. To apply bold, italics or underline assign values as per the following table:

Value	Underline	Italic	Bold
0	no	no	no
1	yes	no	no
2	no	yes	no
3	yes	yes	no
4	no	no	yes
5	yes	no	yes
6	no	yes	yes
7	yes	yes	yes

Setting the Active Data Plot using the Legend

To enable the selection of the active data plot by clicking on the respective data plot type icon in the legend:

1. Select **Format:Page** to open the Plot Details dialog box.
2. Select the **Legends** tab, and then select the **Indicate Active Dataset** check box.

Controlling the Width of the Data Plot Type Icons in the Legend

To control the width of the data plot type icons in the legend:

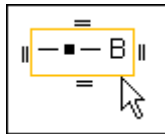
1. Select **Format:Page** to open the Plot Details dialog box.
2. Select the **Legends** tab, and then type the desired value in the **Symbol Width** text box.

Units are % of font point size.

Controlling the Proportions of the Legend Background

To resize the background (the box around the legend):

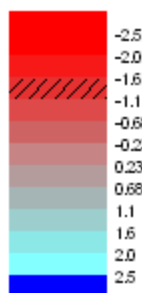
1. Click on the edge of the legend background. Sizing handles (the "=" marks) will appear.



2. Drag a handle to resize the background.

Displaying and Editing Color Scales

The color scale is a specialized object that displays a color map and associated Y or Z levels for color mapped or contour data plots. The color scale displays by default when creating color filled or gray scale contour graphs.



To add a color scale to a graph layer containing a color mapped data plot:

1. Select **Graph:New Color Scale** or right-click in the layer and select **New Color Scale**.

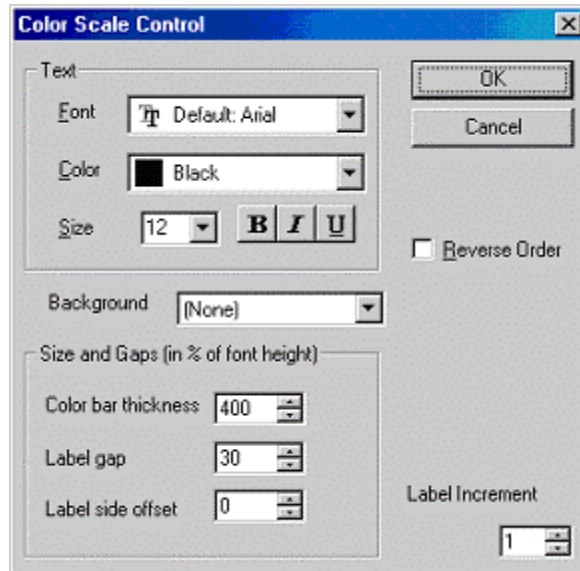
This menu command is only available if the active data plot is color mapped and a color scale is not already displayed.

The numeric format of the color scale is controlled by the **Numeric Formats** tab on the Plot Details dialog box (when the data plot icon is active on the left side of the dialog box). However, to customize the format

of the color scale text, double-click on the color scale or right-click and select **Properties** from the shortcut menu. Both actions open the Color Scale Control dialog box.

Note: By default, the color scale displays vertically. To display the color scale horizontally, click on the color scale and then drag a control handle in the horizontal direction.

The Color Scale Control Dialog Box



The Text Group

Select the desired font, color, and size from the associated controls. The **Size** combination box is in units of points.

The Background Drop-down List

Select the desired background from this drop-down list.

The Reverse Order Check Box

Select this check box to reverse the color map and associated level text order.

The Size and Gaps Group

Set the width of the color scale from the **Color Bar Thickness** combination box.

Set the gap between the color scale and the associated labels from the **Label Gap** combination box.

To shift the labels up and down in relation to the color scale, edit the **Label Side Offset** combination box. Negative values move the labels up in relation to the color scale, while positive values move the labels down.

Units for all controls in this group are in % of font point size.

The Label Increment Combination Box

If your color scale has a large number of levels, the level labels may overlap and be difficult to read. In this case, select or type the desired label increment from this combination box.

For example, to display every *third* label, select **3** from this combination box.

The Set Default Button

Click this button to set the current text settings as the default settings for future color scales in all graph windows in the project.

To learn more about color scales, review the COLOR SCALE.OPJ project located in your Origin \SAMPLES\GRAPHING\2D PLOTS folder.

Advanced Concepts: Constants, Variables and Scripts

Resolving Math Expressions in Text Labels

Origin supports substitution notation when creating text using in-place editing methods or when editing text in the **Text Control** dialog box. You can use this notation to resolve a mathematical expression to a value in the text label.

The syntax is as follows:

$\$(expression)$

In this substitution notation, *expression* is resolved to a value each time the text label is redrawn. The text label is redrawn whenever you move the label or redraw the graph window.

For example:

1. Type the following text in in-place edit mode or enter the expression in the **Text Control** dialog box and click **OK**.


The value of X is $\$(pi^2)$

2. Right-click on the text label that you created and select **Label Control...**

or

2. Press the ALT key while double-clicking on the text label.
3. Select the **Link to Variables (%,\$)** check box and click **OK**. The label now reads:

The value of X is 9.8696

You may need to click the **Refresh** button  on the Standard toolbar to see the change.

Linking Text Labels to Data and Variables

Text labels can employ substitution notation to display information about your data set. This is supported by both in-place and Text Control dialog box text creation and editing methods.

For example, the text label could display “The value of x is *number*.” in which *number* represents a data set value that is accessed via substitution notation.

The worksheet syntax follows:

$\$(WorksheetName, ColNumber, RowNumber)$

To continue with the example, if the cell at row 2, column C, of the Data1 worksheet contains the value 15, then typing the following into a text label...

The value is $\$(Data1,3,2)$.

...would produce the following once you left text edit mode (you might need to refresh the window):

The value is 15.

When using the **%(*expression*)** notation in a text label, you must select the **Link to Variables (%,\$)** check box in the associated **Label Control** dialog box.

Besides displaying worksheet values, you can include string variables in text labels, too. As long as the **Link to Variables (%,\$)** check box in the Label Control dialog box is selected, Origin will substitute the contents of the string variable in the text label.

More on String Variables:

Origin uses a number of string variables for storing data. For example:

- The **%X** string variable contains the drive and path of the current saved project.
- The **%G** string variable contains the current project name.

Thus if your current project MYPROJECT.OPJ is saved to C:\MYFILES\, then typing the following in the Text Control dialog box...

This project is saved to \v(%X%G).

... displays the following label (you may need to refresh the window):

This project is saved to C:\MYFILES\MYPROJECT.

Note: In this example, a special \v command must be placed in front of the string variable in order to display the backslash character in the file path. See *A Note about Displaying the Backslash Character in Text Labels* on page 393.

Inserting Variables Extracted from Imported ASCII Files into Text Labels

Variables extracted from ASCII file header lines can be inserted into a text label in the following way:

1. Create a new text label using standard "in-place" text label creation methods.
2. While in text entry mode, press CTRL + H, or right-click and select **Insert Info Variable**. This opens the **Insert Info Variables** dialog box.

This dialog box will list variables extracted during ASCII file import. You can choose and insert variables as:

- Literal text

If you do not select either the **Insert as Link** or the **Insert as "Property = Value"** check boxes, the value of the variable will be inserted as literal text.

Endocochlear Potential and Pressure at 2 Hz

- Insert as link

Select this box to insert a string that is dynamically linked to the value of a variable. Any change in a string's value will produce a change in the label value when the file is next imported.

To learn more, see *Linking Text Labels to Data and Variables* on page 421.


- Insert as "Property = Value"

Select this box to insert "*variable name = value*" into the text label .

$L_2V_2 = \text{Endocochlear Potential and Pressure at 2 Hz}$

Variables can be viewed from the Script window by typing the command:

Page.info.user. =



 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Associating LabTalk Script with an Object

All objects such as text labels, rectangles, lines, arrows, and other annotations have associated Label Control dialog boxes. The Label Control dialog box is used to name the object (for programmatic control) and to define the object's LabTalk script and script execution trigger. An example of a script execution trigger is to display the object as a button that can be clicked to run the associated script.

In the following example, you create a button from a text label and define the button to open a dialog box containing the message "Hello World!".

Creating the Text Label

1. Click the **New Graph** button  on the Standard toolbar to open a new graph window.
2. Select the **Text** tool  from the Tools toolbar and click in a blank area of the graph. This starts the in-place text editing mode.
3. Type **Hello World**.
4. Press ESC to de-select the label. The Hello World text label displays on the screen.

Changing the Label into a Button

1. Click on the label and then select **Format:Label Control**.
2. Click in the text box at the bottom of the dialog box and type in the following text (this is the script for the control):

type -b "Hello World!";

3. Select **Button Up** from the **Script, Run After** drop-down list.

The Button Up option informs Origin that the script is executed when the button is clicked. Each of the options from the Script, Run After drop-down list establish a different method for script execution. For example, select Moved to execute the associated script when the text label is moved.

4. Click **OK** to close the dialog box.

The Hello World text label now displays on your screen as a button. When you click the button, an Attention dialog box opens and displays the following:



Tip: This button object will not print. If you wish to print a graph with a button, [do this](#):

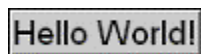
1. From the Origin menu, choose **Edit:Button Edit Mode**.
2. Right-click on your button object and select **Label Control**.
3. Set the **Script, Run After** drop-down list to **None** and click **OK**.
4. Right-click on your text object and select **Properties**.
5. Set **Background** to **Dark Marble** and click **OK**.
6. Choose **Edit:Button Edit Mode** to exit button edit mode.

You will now be able to print your graph, complete with a reasonable representation of your button.

To learn more about programming in Origin, including using Origin C, choose **Help:Programming**.

Editing the Button (Text or Script)

Once the button is activated, you must invoke **Button Edit Mode** to edit the button details -- the button label, the script behind the button, etc.



To invoke Button Edit Mode:

1. From the menu, choose **Edit:Button Edit Mode**.

The **Button Edit Mode** menu command will have a check mark next to it when Button Edit Mode is active. The button object's appearance will be changed; note the word "Text" appearing in the upper left corner of the label.



Button functionality is now disabled and the object can be edited as if it were any other text object.

- To edit the button label, right-click on the object and select **Properties**.
 - To edit the button's script, page attachment method, script triggering event, etc., right-click on the object and select **Label Control**.
 - To delete the button object, right-click on the object and select **Delete** (or press DELETE).
2. When you have finished editing the button details, reselect the **Edit:Button Edit Mode** menu item (removing the check mark from beside the menu item).

This turns off button edit mode and restores the functionality of any script-associated objects in the project.

To learn more about programming Origin, see the Programming Help file (**Help:Programming**).

Presentations, Printing and Graphic Export

Creating a Master Page Layout for all of Your Graph Windows

Origin provides a **master page** feature to simplify the global annotation of graphs. Use the master page to display a consistent background, a company logo, or other labels and images on all or selected graph windows in your project.

Before using this feature, you must create your master page. The master page graph should contain the objects and background that you want to display on other graph windows. You can take a couple of approaches to this:

- You can customize the display of any graph window and then rename the graph window "master" using the window renaming method. Origin recognizes that a window named "master" is to serve as a master page.
- Origin provides a graph template, MASTER.OTP, in which the axes and labels are hidden. To open this template:
 1. Select **File:New**.
 2. Select **Graph**.
 3. Select **Master** from the (Template) **Name** drop-down list (in the Origin program folder).
 4. Click **OK**.

You can customize the display of this window and rename it "master".

Note: To learn more about the master page option, review the MASTER PAGE.OPJ project located in your Origin \SAMPLES\GRAPHING\MISCELLANEOUS folder.

Including a Master Page Layout in Your Presentation

Once you create a master page (and name the graph window "master"), you then control the display of the master items in other graph windows in the project. There are two aspects to this control:

- You can control whether or not the master items are included when you export, copy, or print the graph window. This is a graph page-specific control, set on each graph page's **Plot Details** dialog box. To use this control:
 1. Select **Format:Page** to open the Plot Details dialog box.
 2. Select the **Display** tab.
 3. Select the **Use Master Items** check box.

This will include master items when you export, copy, or print this graph window.

- You can control whether or not the master items display as you view the graph in Origin. To use this control:
 1. Activate any graph window.
 2. Select **View>Show:Master Items on Screen**.

Note: This menu command is not available if the Plot Details **Use Master Items** check box is cleared.

Additional Master Page Notes:

- To open a graph based on the MASTER.OTP template from a LabTalk script, use:

win -t plot master Master;

In addition to opening a graph window from the template, this script renames the window "Master."

- To display master items exclusively in portrait or landscape page orientation, you could instead rename your master graph window "portrait" or "landscape." These window names are also reserved for use by this feature.

If you have renamed your graph window "portrait" and you open a second graph window that is also in the portrait page orientation, then you select **View>Show:Master Items on Screen**, the objects in the portrait graph window display in the second graph window (assuming the Plot Details **Use Master Items** check box is selected).



- You can also include master items in layout page windows. However, by default, the **Use Master Items** check box on the layout page's Plot Details dialog box is cleared. Therefore, you must select this check box to include master items when exporting, copying, or printing. Furthermore, you must select the **View>Show:Master Items on Screen** menu command to display the master items when viewing the layout page in Origin.

Note: To learn more about the master page option, review the MASTER PAGE.OPJ project located in your Origin \SAMPLES\MISCELLANEOUS folder.

The Layout Page

Adding a Graph or Worksheet Picture to the Layout Page Window

To add a graph or worksheet to the layout page window:

1. From the menu, select **Layout:Add Graph** or **Layout:Add Worksheet** when the layout page window is active (or click the **Add Graph**  or the **Add Worksheet**  buttons on the Layout toolbar). These actions open the **Select Graph** (or **Worksheet**) **Object** dialog box.
 2. Select the graph or worksheet in the list box provided.
 3. Click **OK**.
 4. Click once in the layout page window to create a picture of the *default* size.
- or
4. Drag out a box in the layout page window to create a picture of the *specified* size (the size of the rectangle that you drag out with your mouse). Release the mouse button and a picture (object) of the associated graph or worksheet is displayed.

If the source window is a *worksheet* window, the worksheet grid and cell values display as a picture in the layout page window. Text labels in the worksheet window will not display in the layout page window.

If the source window is a *graph* window, all graphics within the graph page display in the layout page window. Text labels and other objects display in the layout page window if at least part of the object is *inside* the graph window page (The gray area in the graph window is *outside* of the page).


Working with Pictures in the Layout Page Window

Making Changes to the Contents of a Picture

To alter the display of the picture in the layout page window, edit the source graph or worksheet child window. To make the graph or worksheet child window active:


1. Right-click on the picture in the layout page.
2. Select **Go to Window** from the shortcut menu.

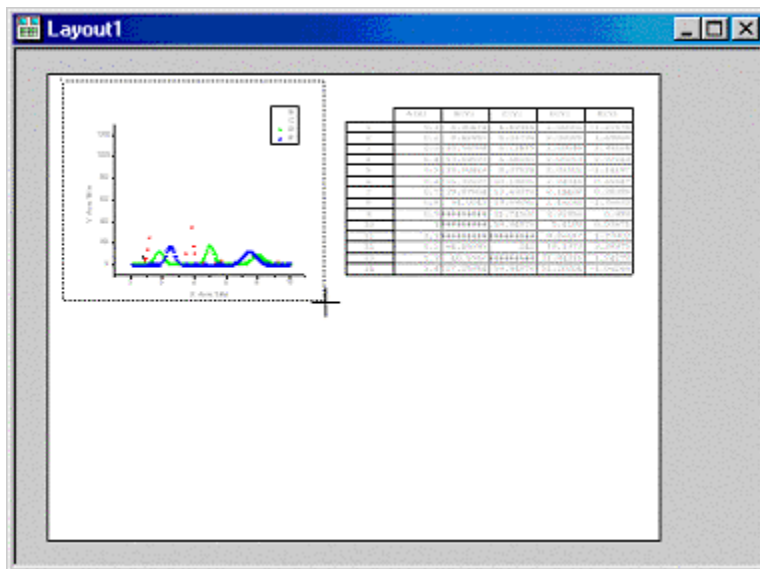
After changing the display of the graph or worksheet, click on the layout page window to see your

changes. If the layout page window does not update, select **Window:Refresh**, or click the **Refresh**  button on the Standard toolbar.

Selecting Pictures

Selecting One Picture

To select a picture in the layout page window, click on the picture. Alternatively, drag a box around the picture with your mouse (**Pointer** tool  selected). Release the left mouse button and a highlighted boundary with control handles displays around the picture. To de-select the picture, click anywhere in the layout page window (off of the picture).



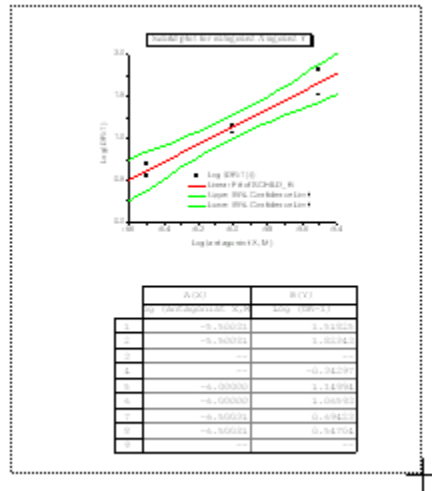
Selecting More than One Picture

To select more than one picture in the layout page window:

1. SHIFT+click on the pictures.

or

1. Drag a box around the multiple pictures using the **Pointer** tool.



Sizing a Picture

To change the size of the picture in the layout page window:

1. Click on the picture to display its bounding box with control handles.
2. Drag on the control handles to resize the picture.

Use the control handles on the horizontal or vertical sides to change the respective dimensions. Use the control handles at the corners to resize proportionally (keep aspect ratio).

3. Click off the picture (but inside the layout page window) to de-select the picture. Note that access to resizing and positioning of the object can be blocked by settings in the object's **Object Properties** dialog box.

Note: Reducing or expanding the size of a worksheet picture in the layout page window controls the display of the number of rows or columns in the picture. The size of the worksheet picture grid --that is the size of the cells and the text -- remains unchanged.

Notes on Proportional Sizing of Pictures

- If you changed the proportions of the picture when resizing, return the picture to its *original proportions* by pressing ALT while clicking and dragging on a control handle. (You can release the ALT key once you grab the control handle.) The picture returns to its original proportions and then sizes proportionally as you drag the control handle. Release the mouse button to display the resized picture with the original proportions.
- To ensure that the picture's proportions are not changed during future sizing, make sure that **Keep Aspect Ratio** is checked on the shortcut menu or select the Keep Aspect Ratio check box on the **Dimensions** tab in the picture's **Object Properties** dialog box (double-click on the layout page picture to open this dialog box).
- Alternatively, to preserve the aspect ratio during resizing, press the CTRL key while dragging on a control handle. Drag the control handle to the desired location. Release the CTRL key and the mouse button to display the resized picture.
- To resize the picture maintaining the current proportions, press CTRL while dragging on a control handle. (You can release the CTRL key once you grab the control handle.) Drag the control handle to the desired location. Release the mouse button to display the resized picture.

Positioning a Picture

To move the picture in the layout page window:

1. Click on the picture and drag it to a new location.
2. Click off of the picture (but in the layout page window) to de-select it.

You can also position and resize the picture using controls on the **Dimensions** tab of the **Object Properties** dialog box:

1. Double-click on the picture to open the **Object Properties** dialog box.
2. Select the **Dimensions** tab.
3. Edit the settings in the **Units** drop-down list and the **Size** text boxes.

Adding a Background to a Picture

As with other objects, you can add a background display to the picture in the layout page window. To add a background display to the picture:

1. Double-click on the picture to open the **Object Properties** dialog box.
2. Select the **Image** tab.
3. Select the **Background** check box and choose a background from the drop-down list.

Note: You can apply this background to individual or to every object in the window. However, once applied to every object in the window, the background display can only be removed from objects individually.

Aligning Pictures

There are several methods of aligning pictures in the layout page window:

- Using the object grid to align pictures.

To enable the display of the object grid:

1. Select **View:Show Grid** when the layout page window is active.

A check mark appears next to this menu command when the object grid is displayed.

Use the grid lines to position pictures in the window. To ensure that the pictures position on a grid line, select **Format:Snap to Grid** when the layout page window is active.

- Using the **Object Edit** toolbar to align pictures.

Use the Object Edit toolbar (**View:Toolbars**) to align pictures (or any other objects) in the layout page window. The buttons on the Object Edit toolbar control the movement of any *active* object(s) in the window.

To make an object active, click once on the picture. To make more than one picture active, SHIFT+click on the desired pictures, or drag a box around multiple pictures to select them all.

- Using the **Object Properties** dialog to align pictures.

1. Double-click on the picture to open the **Object Properties** dialog box.
2. Select the **Dimensions** tab and edit the **Left** or **Top** values in the **Position** Group. Manually edit these boxes for multiple objects to precisely align them vertically or horizontally.

Enhancing the Redraw Speed in a Layout Page Window

There are two ways to increase the redraw speed of the layout page window:

- Show picture placeholders in place of the pictures themselves.

To display a picture placeholder:

1. Click to select the picture.
2. Select **Layout:Set Picture Holder**.

A check mark appears next to the this menu command when a placeholder displays for the selected picture.

To disable the placeholder display:

3. Click to select the placeholder.
4. Select **Layout:Clear Picture Holder**.

or

4. Clear the **Use Picture Holder** check box on the **Image** tab of the picture's **Object Properties** dialog box or right-click on the object and **Clear Picture Holder**.

Picture placeholders can be moved and sized like pictures. You can double-click on the placeholder to open the objects **Object Properties** dialog box. Changes made to the **Background** drop-down list are visible when you disable the picture placeholder display.

Note: Pictures print out regardless of the display of picture placeholders.

- Display the pictures in **Page View** mode independent of the view mode of the associated child window.

You can choose to display all pictures (and additional objects - text, drawing, etc.) in the layout page window in the **Page View** mode, *regardless of the view mode of the picture's child window*. The Page View mode provides faster screen updating than the Print View mode. To display pictures (and objects) in the layout page window in the Page View mode:

1. Select **Layout:Global Speed Control**.

or

1. Right-click in the layout page window (but off the page) and select **Global Speed Control** from the shortcut menu. This menu command is checked when displaying pictures in Page View mode. To disable this command, reselect **Global Speed Control**.

Because the **Page View** uses the screen driver to generate the display (**Print View** uses the printer driver), text placement may not be accurate in the layout page window when the **Global Speed Control** menu command is selected. This should not be too problematic as editing is actually done in the associated child window. Check text placement in the child window by selecting **View:Print View** when the child window is active. Pictures in the layout page window should print just as they appear in the child window Print View mode.

Printing

Checking Your Display Options Before Printing

There are several ways to hide elements of the graph window (see *Hiding Labels, Data, and Layers* on page 368):

- By de-selecting the element from the View menu (**View:Show:Element**).
- Via shortcut menus associated with many graph elements.

If an element is not displayed in the graph window, it will not appear in the printout. If you want an element to appear in the printout, be sure to display it before selecting **File:Print**.

Previewing Before Printing

Before printing a graph or layout page, you will want to check the positioning of labels and other objects on the page. Both Print View (**View:Print View**) and Print Preview (**File:Print Preview**) modes use the printer driver for the page layout information, and so they are both useful for confirming object positioning. However, note the following differences:

- **Print View** mode provides an editable view; it allows use of Origin tools, including the menu commands and dialog boxes. *Print Preview* mode is strictly a viewing mode - no Origin tools are available. Thus, if you want to move objects on the graph page or customize the graph before printing, you must switch to Print View mode.
- **Print Preview** mode provides a display of the entire graph page, including the margins. Print Preview provides the most accurate representation of the printed page. Page zooming tools are provided to enhance viewing.

Print Preview mode provides **Zoom In** and **Zoom Out** buttons to examine the page before printing. The Zoom In button is already selected when entering the previewing mode. Click in the target region of the page to zoom in. To return to the full page view, click the Zoom Out button.

To print from the previewing mode, click the **Print** button. This opens the **Print** dialog box. Confirm print settings and click **OK**.


To exit the previewing mode *without* printing, click the **Close** button.

A Note About Displaying and Printing Fonts

Scalable fonts are usually rotatable, and resize proportionally when you change the size of an Origin graph. For best results, we recommend that you use scalable fonts in your graphs.

Windows contains two types of scalable fonts: *Vector* fonts and *True Type* fonts.

- Windows includes three Vector fonts: Roman, Modern, and Script. Vector fonts are created as needed by an application, based on a set of software instructions that define the characteristics of the font.
- Windows also includes a number of True Type fonts, such as Arial, Times New Roman, and Symbol. These provide a true “What You See Is What You Get” (WYSIWYG) display. The screen display will always match the printed page.

For a list of the True Type fonts in your system, open the Windows **Control Panel** and double-click on the **Fonts** icon. True Type fonts are designated by a **True Type**  icon.

Printer fonts are fonts that are built into your printer. Printer fonts may be scalable fonts, or they may be **bitmapped** fonts, which are *not* scalable. Check your printer documentation to determine what type of fonts come with your printer. If you have a **PostScript** printer, *all of your PostScript fonts are scalable*.

Printing to the Printer


To print the active window:

1. Select **File:Print**.

or

1. Right-click on the title bar of the window and select **Print** from the shortcut menu.

Both actions open the **Print** dialog box. Edit this dialog box to select and configure the active printer, and set the printing options.

Note 1: To print the active window using the current settings in the Print dialog box, click the **Print**  button on the Standard toolbar.

Note 2: To print a window or selected windows from a Project Explorer folder, select the window icons on the right side of Project Explorer and then right-click within the selection and select **Print Window** or **Print Windows** from the shortcut menu. Like the Print button on the Standard toolbar, these shortcut menu commands use the settings in the **Print** dialog box.

The Print Dialog Box

The controls in the **Print** dialog box are dependent upon the active window type (graph, worksheet, Excel workbook, etc.)

Print Dialog Box Controls

The Printer Group

Select the printer from the **Name** drop-down list. If the printer is not in the list of available printers, add the printer through the Windows Control Panel.

Click the **Properties** button to set options specific to the printer driver selected from the **Name** drop-down list.

Select the **Print to File** check box to print the selected window(s) to a file. This must be selected when creating a PostScript file.

The Print Graph, Print, or Print Range Group

When the Graph, Function Graph, or Layout Page Window is Active

Current/All Open/All	Print the current, all open, or all graph, function graph, or layout page windows in the project.
Options	<p>The Options button opens the Geometry tab of the More Print Options dialog box.</p> <p>The Graph Page Size group displays the current graph page size, as specified on the Print/Dimensions tab of the graph page's Plot Details dialog box.</p> <p>The Printer Page Size group displays the current printer page dimensions.</p> <p>You can print a graph page that is smaller or larger in dimensions than the current printer page dimensions, and maintain the specified graph page dimensions in the printout.</p> <p>A graph page with dimensions that are smaller than those of the printer page will print on one page. The upper-left corner of the</p>

Options (continued)	<p>graph will be positioned in the upper-left corner of the printer page (maintaining the printer margin).</p> <p>A graph page with dimensions that are larger than those of the printer page will print on multiple pages.</p> <p>The controls for the printed graph size are provided in the Use Printer Default Dimensions For group. To ensure that the Width and/or Height values listed in the Graph Page Size group control the size of the printed graph, clear the Width and/or Height check boxes in the Use Printer Default Dimensions For group. When the Width and Height check boxes are selected (default), Origin will adjust the graph page to fit the printer page, independent of the Graph Page Size group settings.</p> <p>For example, if the width of a graph page is set to 20 inches and the height is set to 8 inches, while the printer page width is 10 inches and the height is 8.5 inches, and the Width check box is cleared but the Height check box is selected (in the Use Printer Default Dimensions For group), then Origin will print the graph on two pages (because $20 \text{ inches} / 10 \text{ inches} = 2$).</p> <p>Note that when you edit the controls in the More Print Options dialog box, the Plot Details dialog box updates to reflect your changes. Similarly, when you edit the controls in the Plot Details dialog box, the More Print Options dialog box updates.</p> <p>To display crop marks that denote the unprintable area on the printer page, select the Print Crop Marks check box.</p>
Skip Points	<p>Worksheet Data, Skip Points controls the number of worksheet data points displayed in the printed graph(s). When this check box is selected, the Maximum Points Per Curve text box displays. Specify the maximum number of points to print for each data plot in this text box. Skipping points increases the printing speed of data plots containing large data sets. If the data set is larger than the specified limit, Origin excludes the necessary number of data points, distributed evenly through the data set. This option does not effect the worksheet or screen display of the data set. When this check box is selected, Origin also disables its high-quality dash lines and hatch patterns, converting them into printer supported forms.</p> <p>Similar to the Worksheet Data, Skip Points check box and text box, the Matrix Data, Maximum Points check box and text boxes control the number of matrix data points displayed in the printed graph.</p>
Enable Color as Gray Scale/Use Simplified Colors	<p>Origin provides two controls for printing a color graph as a black-on-white output: the Enable Color as Gray Scale check box and the Use Simplified Colors check box. Only one of these check boxes is available when you select File:Print. Origin activates one of the check boxes after querying the default printer driver to determine how many colors the printer supports.</p> <p>For printers that support only <i>two</i> colors, the Enable Color as Gray Scale check box is made available.</p> <p>If you clear this check box, Origin prints black-on-white. In this case, axes and labels will output as black-on-white, irrespective of their color. (In Origin 6.0, if the graph background was black and the axes were white, the axes were not visible in the output because both the background and the axes were printed as white.)</p> <p>If you select this check box, Origin sends to the printer the same colors as those for the screen and lets the printer handle them the best it can.</p> <p>For printers that support more than two colors (this does not imply that the printer is a color printer, because it could support multiple non-dithered shades of gray), the Use Simplified Colors check box</p>

Enable Color as Gray Scale/Use Simplified Colors (continued)	<p>is made available.</p> <p>If you clear this check box, Origin sends to the printer the same colors as those for the screen and lets the printer handle them the best it can.</p> <p>If you select this check box, Origin prints black-on-white as described for the Enable Color as Gray Scale check box.</p>
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When the **Worksheet** or **Matrix** Window is Active

Selection	<p>Select the Selection check box to print a range of data. Type the desired column and row range in the associated text boxes.</p> <p>Alternatively, highlight the desired worksheet or matrix data <i>before</i> opening this dialog box. Select the Selection check box to display (and print) the selected range in the associated text boxes.</p>
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When the **Notes** Window is Active

All	If the text in a notes window extends beyond a page, select the All radio button to print all pages in the window.
Pages	To print specific pages of a notes window, select the Pages radio button and type the desired page values in the associated text boxes.

When the **Excel** Workbook is Active

Print Range	To print a range of pages, select the Pages radio button and then specify the page range in the From and To list boxes.
Print What	Select the desired radio button to print a sheet, a selected range, or an entire workbook.

The **Copies** Group

Type or select the number of copies you want to print from the **Number of Copies** spin box.

Select the **Collate** check box when printing multiple copies of multiple windows. When this check box is selected, multiple copies are collated.

The **OK** Button

Click this button to print using the current **Print** dialog box settings.

Printing to a PostScript File

Printing Your PostScript File

To print a PostScript file to the printer, perform the following:

1. Go to the DOS prompt. Change from the current directory to the directory that contains the PostScript file (or include a path in the next step).
2. At the DOS prompt, type:

COPY FileName PrinterPort

where **FileName** is the PostScript file name and extension, and **PrinterPort** is an available printer port with a PostScript output device. This command prints a hard copy of your PostScript file.

For example, to print the GRAPH1.PS file to a PostScript printer connected to LPT1, type the following at the DOS prompt:

```
COPY GRAPH1.PS LPT1
```

How PostScript Files Differ from Encapsulated PostScript Files

PostScript files (PS) contrast with Encapsulated PostScript files (EPS) in that EPS files are intended to be included in other documents (such as Microsoft PowerPoint®). EPS files lack some of the “overhead” commands needed to produce hard-copy output on PostScript printers because it is assumed that the document in which the file is embedded will handle this. Consequently, EPS files cannot be printed by themselves.

Troubleshooting Printing Problems

- The Layer Dimensions in the Printed Page are Incorrect

If you are printing a graph window and the layers in the printed page do not match the dimensions specified on the **Size/Speed** tab of the layer's **Plot Details** dialog box, then modify the **X Scale Factor** and the **Y Scale Factor** combination box values on the **Miscellaneous** tab of the **Options** dialog box (**Tools:Options**).

- The Graph Labels are Shifting Location when Printing

Origin's default viewing mode is **Page View (View:Page View)**. Page View provides fast screen updating, but does not guarantee exact text placement on the screen unless you are using a typeface scaling software (such as Adobe Type Manager).

To make sure your labels are correctly positioned before printing, switch to either **Print Preview** mode (**File:Print Preview**) or **Print View** mode (**View:Print View**). Both view modes provide a true WYSIWYG display (Note that Print Preview mode is *most* reliable).

- A Graph Label Prints Partly off the Page

If a label in the printed graph is truncated, re-check the label position in the graph window. Labels (or sections of labels) that extend beyond the page are not displayed in the printout. The left and top border of the page are determined by the left and top edge of the graph window. The right and bottom border of the page are determined by the gray region in the graph window.

- Changing Printer Drivers Alters Objects in Graph Windows

When Origin draws a graph on your computer screen it queries your printer driver for object sizing and positioning information. If you create a graph using one printer driver, then change your default printer driver (or open the project on a second computer that has a different default printer driver), Origin may re-size and re-position objects in the graph window.

This is not a bug in Origin but rather a problem related to the fact that different printer drivers have different sizing and positioning characteristics. The only solution to this problem is to create and display/print graphs using the same printer driver, or to re-size and re-position the objects as desired after switching printer drivers.

- Opening a Project on a Different Computer Changes the Selected Font

If you open an Origin project file that was created on a different computer and the project file uses a font that was on the original computer but is not installed on your computer,

then Origin will choose a substitute font. If you do not like the substituted font, the only solution is to manually pick a new font from the list of fonts loaded on your computer. For example, to change the font of a text object in an Origin graph window, double-click on the text object and then select a new font from the **Font** drop-down list. Most application programs, including Origin, cannot display or print fonts that are not installed on your computer.

- Origin Doesn't Update the Graph Page Orientation when Opening a Project with a Different Printer Driver Active

If you open an Origin project file that was created with a different printer driver, you may need to manually update the graph to reflect your current printer driver settings. To do this:

1. Select **File:Page Setup**.
2. Select **Portrait** or **Landscape** orientation.
3. Click **OK**. Origin updates your graph window based on your current printer driver settings.

Graphic Export

Exporting Your Graph or Layout Page Using the Clipboard

To paste the page content of the active graph or layout page window as a picture in another application:

1. In Origin, select **Edit:Copy Page**.
2. In the importing application (such as Word), select **Edit:Paste Special**. In Word, this menu command opens the **Paste Special** dialog box.
3. Select **Picture** from the **As** list box.
4. Select the **Paste** radio button.
5. Click **OK**. Your graph or layout page displays as a picture in the destination application.

To control the default size of the picture in the destination application, edit the **Copy Page** group on the **Page** tab of the **Options** dialog box (**Tools:Options**).

Exporting Your Graph or Layout Page to an Image File

Which Export Format Should I Choose?

The format that you choose will depend on the target application. Publishers often have strict requirements for image file formats, so be sure to get details before creating your images.

Formats Common to Print Publishing

Extension	Format Name	Features
TIF	Tag Image File	Raster format, ColorSpace options, Monochrome to True Color, File compression.
TGA	Truevision Targa	Raster format, 256 color to True Color.
EPS	Encapsulated Postscript	Vector format, ColorSpace options, True Color

Extension	Format Name	Features
PDF	Portable Document Format	Vector format, ColorSpace options, True Color

As mentioned, vector formats are generally preferred for their scalability. It might seem reasonable to expect that vector images should be infinitely scaleable, but the information necessary to describe these images can be considerable if data sets are very large. Origin provides the option to limit resolution for vector formats (**Tools:Options**, Page tab). For formats that have ColorSpace options, publishers typically prefer CYMK over RGB.

Formats Common to Web Publishing

There are two important considerations when creating images to be used on the web; you want to:

- Minimize file size to increase download speed.
- Choose a format that is supported by commonly used browsers.

The two most widely supported web image formats are JPG and GIF (GIF requires licensing and so is available with OriginPro only). PNG is growing in popularity as a replacement for GIF because it does not require licensing.

Formats Common to Web Publishing:

Extension	Format Name	Features
JPG	Joint Photographic Experts Group	Raster, Grayscale or True Color, Adjustable compression (lossy).
GIF	Graphics Image Format	Raster, 256 color, Lossless compression.
PNG	Portable Network Graphics	Raster, Monochrome, 16 or 256 colors, or True Color (24 bit RGB), Lossless compression.

Note that you must balance color and detail with download speed; the lower the color density and resolution, the faster the download speed. However, there may be times when you decide to sacrifice some download speed for more color or sharpness.

Origin provides a default color palette of 24 colors chosen from colors found on the Windows palette. So, unless you need custom or True Color, GIF and 256 Color PNG images are a logical choice for web publishing.

If custom colors are needed, (you can add a limited number of colors to your Origin palette up to a maximum of 40), or you are setting color by RGB value, then you will do better with True Color. In such cases, PNG or JPG would be the better choices.

Since web pages are viewed on a computer screen, export at a resolution that approximates that of a computer monitor – 72 to 96 dots per inch (dpi).

Controlling the Size of the Exported Image

The physical page size of exported Clipboard (**Edit:Copy Page**) and vector images (**File:Export Page...**) is controlled by settings on the Page tab of the Options dialog box (**Tools:Options**). For further information on this dialog box, see *Setting Your Preferences; the Page tab* on page 658. The settings on the Page tab do not affect the size of raster images.

To illustrate the effect of the various Page tab options on the dimensions of Clipboard and vector images, we created a simple Origin graph, with a page size of 10.5 in. by 8.13 in., and exported it to MS Word 97. Monitor resolution was 96 dpi.

Ratio was set to 100 (%).

Margin Control was set to Page.

The following image sizes were reported by Word:

Setting	Clipboard (in.)	Vector Image File (EMF) (in.)
Simple	8.13 x 10.5	8.13 x 10.5
Avanced, Resolution=96	8.13 x 10.5	8.13 x 10.5
Advanced, Resolution=300	8.13 x 10.5	25.4 x 32.8
Advanced, Resolution=600	8.13 x 10.5	50.8 x 65.6
Advanced, Keep Size	8.13 x 10.5	8.13 x 10.5

Note that *only the Copy Ratio affects the dimensions of the Clipboard image*. The other settings -- Simple, Advanced (various resolutions), etc. have no effect on the size of the Clipboard image.

Conversely, testing showed that the dimensions of the inserted vector file were affected only by the **Advanced** settings (Resolution) and were *not* affected by the **Copy Ratio**. Note that reported image dimensions may vary by container application.

When producing raster images, keep in mind that the image has no fixed size; the “size” of the image is a function of the page size (normally determined by your printer), the resolution of the output device (monitor, printer, etc.) and the resolution of the image. If, for example, your printer’s page dimensions (**Format:Page**) are 10.5 in. by 8.13 in., and you export your graph as a 600 dpi TIF file, then display it on your computer’s monitor at 96 dpi, the rendered image will be quite large – much larger than can be viewed on a computer monitor at a resolution of 96 dpi. However, when you print your graph with a 600 x 600 dpi printer, it is rendered at the dimensions of the printer’s page size – 10.5 in. by 8.13 in.

It is important to note that while high resolution, True Color raster images do a good job of faithfully reproducing complex graphs, file sizes can be very large and in some cases, the export may fail. For instance, a 600 x 600 dpi TIF file rendered in 24-bit color using a page size of 10.5 in. x 8.13 in. will be over 90 MB in size. Experience has shown that the ability to produce such high resolution, high color files is system dependent.

Formats for Use by Other Applications

If you intend to edit your graphic file in another application, then you should choose that application's native file format or one of its supported formats.

Formats for Use by Other Applications

Extension	Format Name (type)	Owner Application
AI	Adobe Illustrator (vector)	Abobe Illustrator
BMP	Bitmap (raster)	Windows Paint

Extension	Format Name (type)	Owner Application
CGM	Computer Graphics Metafile (vector)	Wordperfect
DXF	AutoCAD Drawing Interchange (vector)	AutoCAD
EMF	Enhanced Metafile (vector)	MS Office Applications
PCX	Zsoft PC Paintbrush Bitmap (raster)	PC Paintbrush
PDF	Portable Document Format (vector)	Adobe Acrobat
PSD	Adobe Photoshop (raster)	Adobe Photoshop
WMF	Windows Metafile (vector)	MS Office Applications

These formats may be raster or vector. There are fewer vector format editors available and some of those programs will 'rasterize' a vector format when it is loaded in the editor. Consult your owner application's documentation for details.

A Note on Making 35 mm Slides

A survey of service bureau websites showed that most were able to process files created by one of two methods:

- Export to common image formats such as EPS, BMP, JPG, etc.
- Print to file using a PostScript compatible print driver.

Note that the submission requirements of service bureaus varies and it is best to check with the service that you plan to use for suggested file formats, print drivers, image sizes, etc. Some sites even make available a downloadable driver for generating 35 mm slide-convertible files.

Try to keep your file sizes small, as you will probably be submitting your files electronically. Large files will increase data transfer times, and may increase slide production costs. Some service bureaus provide an FTP option for submitting large files.

To prepare an Origin graphic file for slide production:

1. Install (locally) a PostScript compatible printer driver and configure it to **Print to File**.

This PostScript compatible print driver must allow one of the following:

- A "paper size" defined as **35 mm slide**.
- A custom paper size of **7.33 in. by 11 in.**

To configure the printer for a custom (slide) size:

1. Right-click on the PostScript compatible printer driver icon in the **Printers** folder and select **Properties**.
2. Select the **Paper** tab.
3. Select **35 mm** from the **Paper Size** list box (if it is available) and click **OK**.
4. If 35 mm is *not* available in the Paper Size list box, select **Custom**.

5. Select the **Landscape** radio button in the **Orientation** group.
6. Click **Custom** to set the size of **7.33"** length and **11"** width (note that some drivers will allow you to change the "Custom" name to "35 mm").
7. Click **OK** (twice).

To create an Origin graph file for slide production:

Select your PostScript-compatible printer driver (configured to print to file). If you have created your graph using another printer driver, you should update your graph to use your PostScript compatible print driver with its custom paper size:

1. Select **File:Page Setup**.
2. Select the **Printer** button.
3. Choose your PostScript compatible printer from the **Printer Name** drop-down list. Even if it is already selected, click the **OK** button.
4. Click **OK**.
5. If you get an attention prompt asking whether you want to resize the page to match the printer, say **Yes**. Before you print to file in Origin, select **View:Print View**. Reposition text and drawing objects, as needed.
6. Select **File:Print** to print the graph.

You will be prompted for a file name. Most service bureaus that make slides will accept a file name extension of .PS. Other acceptable files types may include: PRN, EPS, TIF, GIF (OriginPro only), BMP, PNG, and PDF. As mentioned, you are advised to check with your service bureau for recommendations on submitting compatible files.

Working with Excel in Origin

Starting New Projects with an Excel Workbook Window Open

You can opt to make the Excel workbook window the default child window in your new Origin project files. This will also have the effect of launching an instance of Excel in the Origin workspace.

To specify an Excel workbook as the default new project window:

1. Select **Window:Origin Options** when an Excel workbook is active, or **Tools:Options** when any other child window is active. Both menu commands open the **Options** dialog box.
2. Select the **Open/Close** tab.
3. From the **Start New Project With** drop-down list, select **Excel Workbook**.
4. Click **OK**.


You are prompted to **Save as Origin's startup options?**

- **Yes** saves the dialog box settings for *future* Origin sessions.
- **No** applies your changes to the current Origin session only (Note that you can open and close Origin projects without closing the Origin session).

Opening a Workbook in Your Project

You can open existing Excel workbook files, or you can create new workbook files, in your Origin project.

To open an existing workbook in Origin:

1. Select **File:Open Excel** or click the **Open Excel**  button on the Standard toolbar. Both open the **Open** dialog box with 'Excel (*.XLS)' selected from the **Files of Type** drop-down list.
2. Choose your folder from the **Look In** drop-down list.
3. Choose your workbook file from the list box and click **Open**. This action opens the **Open Excel** dialog box.
4. Select **Open as Excel Workbook** to open the file as an Excel workbook.

If you select the **Open as Excel Workbook** radio button, Origin creates and names the workbook **Book n** , where n is the lowest available number (that does not duplicate an existing window name). Additionally, Origin displays the *full path* and *file name* of the linked Excel file.

Additionally...

- You can use Excel's spreadsheet tools to process your data, within the Origin workspace.
- You have direct access to Origin's 2D graphs. Once you have plotted your data in Origin, you can use Origin's analysis tools to analyze your plot.

- You can save the workbook externally, allowing you to link your Origin project to a source Excel workbook file. This allows you to dynamically link a shared Excel project file to your Origin project.

Alternatively, you can save the workbook internally and it becomes part of your Origin project file. This makes it easy to bundle supporting Excel data files with your Origin project file.

or

4. Select **Open as Origin Worksheet(s)** to open the file as one or more Origin worksheets.

If you select the **Open as Origin Worksheet(s)** radio button, Origin creates a worksheet window for *each* sheet selected from the **Worksheets** list box (in the **Open Excel** dialog box) and names the worksheet(s) *SheetName*. For example, if Sheet1 and Sheet2 are selected from the **Worksheets** list box, Origin names the resultant worksheets Sheet1 and Sheet2. Origin sets the column type for each of the worksheet columns to **Text & Numeric**.

If a workbook sheet includes formulas to calculate values, Origin displays the calculated values in the resultant worksheet.

Additionally...

- You have no access to Excel's spreadsheet tools in Origin, but -- unlike the workbook option -- you gain full access to Origin's graphing and analysis features.
- Your data will no longer be connected to the source workbook. Changes you make to the data will not be reflected in the original workbook.

5. Click **OK** to close the dialog box and open the workbook or worksheet(s).


To create a new workbook in Origin:

1. Select **File:New** to open the New dialog box.
2. Select **Excel** from the **Window Type** list box and click **OK**.

or

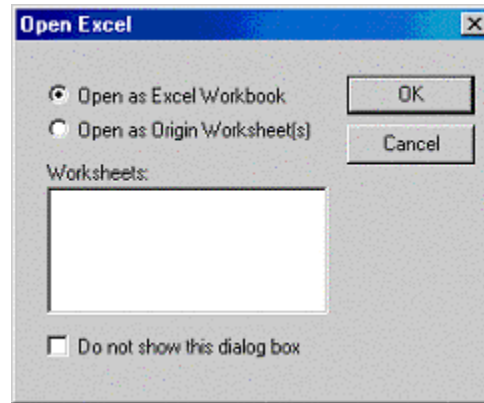
1. Click the **New Excel**  button on the Standard toolbar.

Origin creates and names the new workbook **Book n** , where n is the lowest available number (that does not duplicate an existing window name). The **Book n** workbook contains four sheets, **Sheet1** through **Sheet4**.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

The Open Excel dialog box

When you open an existing Excel workbook (*.XLS) file, Origin's Open Excel dialog box opens.



Open Excel Dialog Box Controls

- The Open as Excel Workbook Radio Button

Select this radio button to open the existing Excel workbook as an Excel workbook. This option allows you to use Excel tools when the workbook is active in the Origin workspace.

- The Open as Origin Worksheet(s) Radio Button

Select this radio button to open the selected sheet(s) of the Excel workbook as an Origin worksheet(s). The data displays in the worksheet(s) and loses its association with the Excel workbook file.

- The Worksheets List Box

If the existing Excel workbook contains multiple sheets and the Open as Origin Worksheet(s) radio button is selected, the available workbook sheets are listed in this box.

Select the sheets to open as worksheets from this list box. Click to select a single sheet, SHIFT+click to select a range of sheets, or CTRL+click to select nonconsecutive sheets.

- The Do Not Show this Dialog Box Check Box

Prevent this dialog box from opening when you select an Excel file from the Open dialog box (**File:Open Excel** or the Open Excel button on the Standard toolbar), or when you select an Excel file from the “Recently Used Files” list in the **File** menu. When this check box is selected and you click OK, Origin automatically opens future Excel files using the last selection in the dialog box. For example, if the Open as Excel Workbook radio button is selected and the Do Not Show this Dialog Box check box is selected, then after clicking OK, Origin opens future Excel workbooks as workbooks. If the Open as Origin Worksheet(s) radio button is selected and the Do Not Show this Dialog Box check box is selected, then after clicking OK, Origin opens all sheets in future Excel workbooks as worksheets.

To re-enable the display of this dialog box, select the **Opening Excel Files** check box on the **Excel** tab of the **Options** dialog box (**Window:Origin Options** when a workbook is active, or **Tools:Options** when any other child window is active).

Saving a Workbook Separately from the Project

Like other child windows, workbook windows can be saved separately from the project.

To save the active workbook to a *.XLS file:

1. Right-click on the workbook window title bar and select **Save Workbook As** from the shortcut menu.

or

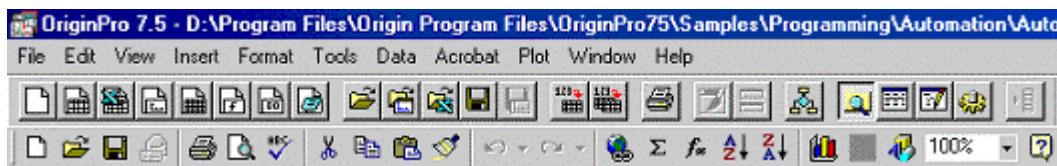
1. From the main menu, select **File:Save Window...**

Both menu commands open the **Save As** dialog box with **Excel (*.XLS)** selected from the **Save as Type** drop-down list.

2. Enter the **File Name** and click **Save**.

Toolbars and Excel

When a workbook is active, both the Origin and Excel Standard toolbars display. All buttons on Origin's Standard toolbar are active except the **Refresh** and **Duplicate** buttons.



Origin's 2D Graphs, 2D Graphs Extended, and 3D Graphs toolbars are available if open.

To open Origin toolbars when an Excel workbook is active:

1. Select **Window:Origin Toolbars**. This menu command opens the **Toolbars** dialog box. Select the desired toolbar check boxes and click **Close**.

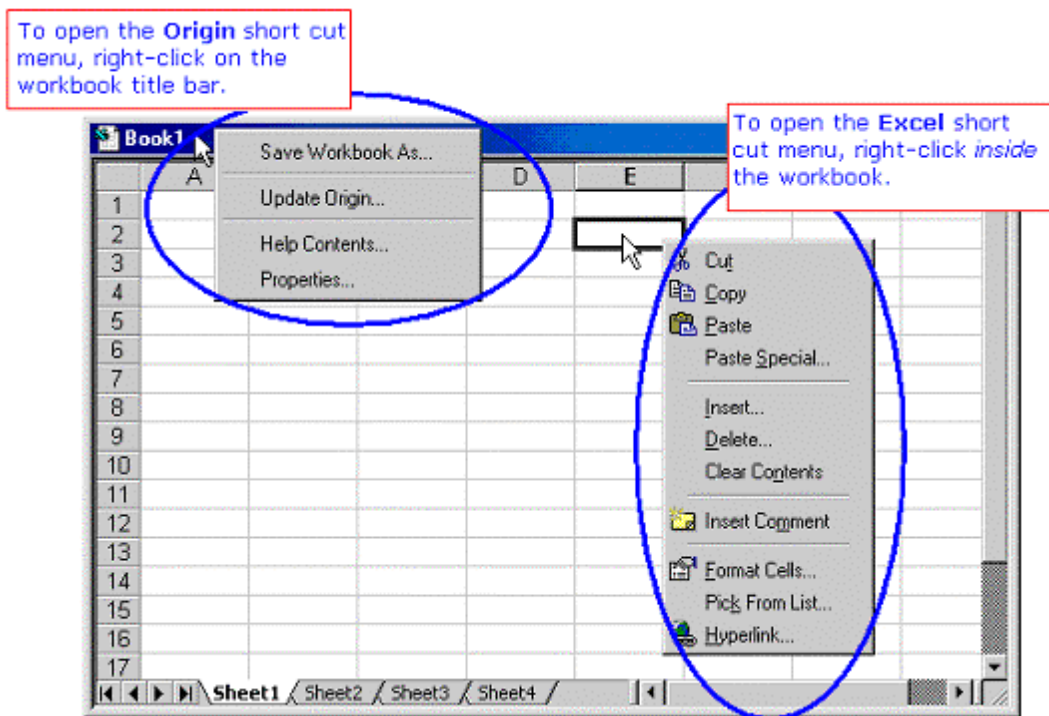
All buttons on Excel's Standard toolbar are active except the **New Workbook**, **Open**, **Save**, **Print**, and **Print Preview** buttons. All other Excel toolbars that are open are available.

Note: Origin includes a toolbar spacer that stabilizes the toolbar region when child window activity is changed in Origin. The toolbar spacer is the reserved space for toolbars located below the menu bar. The height of the toolbar spacer is determined by the maximum height required to display all the selected docked toolbars for any of the child windows in the project. Because the Excel toolbars display when a workbook is active, the workbook window (if open in the project) generally "determines" the height of the toolbar spacer. If you have switched child window activity from the workbook to any other child window, and you want to manually reset the toolbar region for the currently active child window, right-click on the toolbar spacer and select **Hide Toolbar Spacer** from the shortcut menu.

Excel Workbook Shortcut Menus

When a workbook is active, Origin provides a combination of Origin and Excel shortcut menus:

- Excel shortcut menus are available by right-clicking inside the workbook.
- The Origin shortcut menu is available when you click on the workbook window title bar.



Origin Shortcut Menu Commands Available from the Workbook Title Bar

Save Workbook As

Saves the active workbook to a file. Opens the **Save As** dialog box.

Update Origin

If you rename a workbook sheet that contains data that is plotted in a graph window, this shortcut menu command updates the connection between the data plot and its source sheet.

After selecting the command, Origin opens the **Associate Excel Worksheet** dialog box. Edit this dialog box to re-establish the connection between the data plot and the sheet.

Occasionally, the workbook window, or other windows containing workbook data, may become inactive. This condition is apparent when the window containing workbook data has a blank display. To reactivate the window and restore its display, select this shortcut menu command.

Help Contents

Opens **Origin's** online Help file.

Properties

Opens the **Workbook Properties** dialog box. Edit this dialog box to rename the workbook window and control how the workbook is saved when you save your project.

This dialog box also lists the workbook sheets that contain plotted data, and the associated Origin index numbers. Index numbers are included in the names of data plots that contain workbook data.

Working with Workbook Windows

Renaming the Workbook

To rename a workbook window:

1. Right-click on the workbook window title bar and select **Properties** from the shortcut menu. This menu command opens the **Workbook Properties** dialog box.
2. Type a new name in the **Window Title** text box and click **OK**.

If the workbook is saved externally to the project, the full path and file name also display in the title bar.

Renaming Sheets in the Workbook

If you create a data plot from your Excel workbook data and, subsequently, you rename the workbook sheet, you lose the association between the data plot and the source data. To re-establish the connection between the data plot and the workbook sheet:

1. Right-click on the workbook window title bar and select **Update Origin** from the shortcut menu. This opens the **Associate Excel Worksheet** dialog box.
2. Highlight the renamed workbook sheet and click **OK**.

Note1: If you have renamed *multiple* workbook sheets of plotted data, Origin reopens this dialog box automatically when you click OK. Repeat step 2 above, as needed.

Note 2: If you do not update Origin manually during the current session, Origin will prompt you to do so when you try to save your project file.

The Associate Excel Worksheet Dialog Box

The Excel Worksheets List Box

When you rename a workbook sheet that contains plotted data, Origin must be informed of the new sheet name. Select the new sheet name from the **Excel Worksheets** list box.

The Remove Button

If you delete or rename a workbook sheet from which data is plotted, click this button to delete the associated data plots from all graph windows.

The OK Button

Click this button to re-associate the selected workbook sheet (in the **Excel Worksheets** list box) with the data plot.

Note: If you have renamed multiple workbook sheets that contain plotted data, Origin re-opens this dialog box automatically after clicking **OK**. Edit the dialog box for the workbook sheet specified in the text at the top of the dialog box.

Deleting Sheets from the Workbook

If you create a data plot from your Excel workbook data and, subsequently, you delete the workbook sheet, you must update Origin:

1. Right-click on the workbook window title bar and select **Update Origin** from the shortcut menu.

This opens the **Associate Excel Worksheet** dialog box. Click the **Remove** button to update Origin and remove all data plotted from the (deleted) sheet.

Creating a Matrix from the Workbook

You can select a contiguous range of Excel workbook data and create an Origin matrix directly. To create the matrix:

1. Highlight the workbook data.
2. From the menu bar, select **Window>Create Matrix**.

This menu command opens a new matrix window and fills the matrix with the highlighted data. This is particularly useful for creating an array of Z values that can be used to generate a 3D surface plot.

Origin Program Access to Excel Workbook Data

When a workbook is the active child window, the user-interface is -- with the exception of a small subset of Origin window and plotting options -- provided by Excel. Thus, when a workbook is active, the **Format**, **Tools**, and **Data** menus are Excel menus. However, Origin does provide access to the workbook data using LabTalk, Origin's built-in scripting language:

- Running Excel Macros in Origin

Excel macros can be run from Origin using LabTalk. Origin uses an **excel** object method to run Excel macros from Origin. For the Excel macro to run properly, you must supply the correct arguments using the **excel** object method. LabTalk will accept no more than five arguments. Additionally, the workbook containing the Excel macro must be the active window.

To run the macro, type the following in the Script window and press ENTER:

```
Excel.RunRange( SheetName , RangeName , Arg1 , Arg2 , ... , Arg5 )
```

Where *SheetName* is the name of the sheet containing the macro, *RangeName* is the name of the cell on the sheet where the macro starts (for example, C6), and *Argn* are the correct arguments for the macro (not exceeding five arguments).

The return value after executing the **excel** object method comes from the macro.

- Invoking Visual Basic Application Functions in Origin

In addition to Excel macros, you can invoke Visual Basic application functions in Origin. As with macros, these functions are invoked using LabTalk's **excel** object. For the Visual Basic application function to run properly, you must supply the correct arguments with the **excel** object method. LabTalk will accept no more than five arguments. Additionally, the workbook containing the Visual Basic application function must be the active window.

To run the Visual Basic application function, type the following in the Script window and press ENTER:

```
Excel.Run( FunctionName , Arg1 , Arg2 , ... , Arg5 )
```

Where *FunctionName* is the Visual Basic application function, and *Argn* are the correct arguments for the function (not exceeding five arguments).

The return value after executing the **excel** object method comes from the function.

- Read or Set Cell Values

Please refer to the topic *Working with Excel Workbook Datasets in Origin* in the Programming Help file (**Help:Programming**).

Plotting Workbook Data

How Origin Denotes Plotted Workbook Data

The Excel workbook dataset naming convention is similar to the Origin worksheet dataset naming convention, but includes information on the sheet number in the workbook. Excel workbook datasets are named using the following syntax:

WorkbookName_ColumnName@SheetNumber

Where ***WorkbookName*** is the workbook name, ***ColumnName*** is the workbook sheet column name, and ***SheetNumber*** is a numeric value reflecting *the order in which data was plotted* from the sheets in the workbook. It is *not* the ***Sheetn*** number that displays at the bottom of the Excel workbook tab (for example).

Open a new Excel workbook and enter data on Sheet1 through Sheet4. Then plot the data from the four sheets in the following order: Sheet1, Sheet4, Sheet2, and Sheet3. The numeric values of ***@SheetNumber*** will be:

Sheet1*	no number
Sheet2	@3
Sheet3	@4
Sheet4	@2

*When referencing the first plotted sheet, Origin does not use @1.

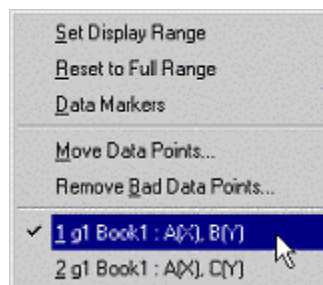
To verify the **@SheetNumber** value for each sheet that contains plotted data:

1. Right-click on the workbook window title bar.
2. Select **Properties** from the shortcut menu.

The workbook sheets and their associated **@SheetNumber** values display in the **Sheet Name - Origin Index** list box.

References to plotted Excel workbook data are found in the same locations as are references to plotted Origin worksheet data. These locations include:

- the data list at the bottom of the **Data** menu



As with Origin worksheets, the data list at the bottom of the **Data** menu lists each of the data plots included in the active layer of the graph window. If the Y data is plotted versus X data, both datasets are listed. If the Y data is plotted versus workbook row number, then Origin lists the starting row number and the increment (in most cases, this value will be one).

- the graph legend

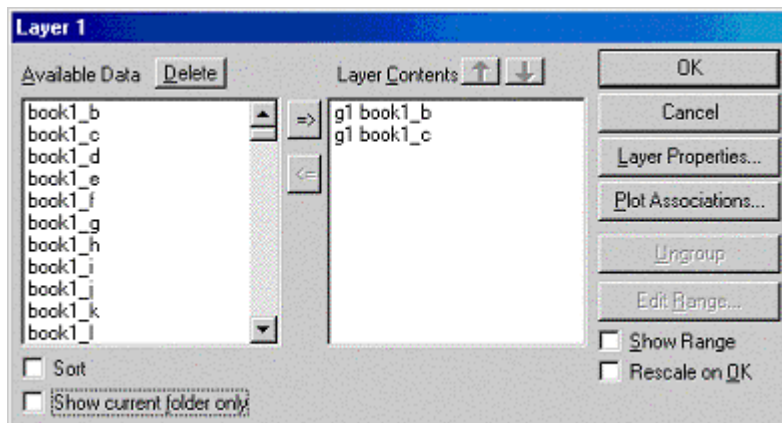
The graph legend displays either the workbook sheet's column titles, the sheet's column names, or the full dataset name for the data plots. If column titles are present in the workbook sheet, they are displayed in the legend by default. If no column titles are present, the column name is displayed by default.

To display the full workbook dataset name instead of the workbook column name:

1. Select **Format:Page** when the graph window is active. This menu command opens the Plot Details dialog box with the graph icon selected on the left side of the dialog box.
2. Select the **Legends** tab.
3. Select the **Full Dataset Name** check box and click **OK**.

Recall that the **@SheetNumber** does not display for data from the first workbook sheet to be plotted (see above example).

- the Layer *n* dialog box



As with Origin worksheets, plotted workbook datasets are also displayed in the **Layer Contents** list box of the **Layer *n*** dialog box (To open this dialog box, double-click on the layer icon in the upper-left corner of the graph window). In the Layer Contents list box, Origin displays the workbook dataset that supplies the Y values in the data plot.

Interactively Selecting Cells and Assigning their Plotting Designation (Default Plotting Method)

This plotting method uses the interactive **Select Data for Plotting** dialog box. This dialog box allows you to select data from the Excel workbook and assign the desired plotting designation (**X**, **Y**, etc.) by clicking a button within the dialog box. This bypasses the need to assign plot designations through the **Worksheet Column Format** dialog box, as you would normally do if the data were stored in an Origin worksheet.

This interactive plotting method also allows you to create multiple data plots that can be displayed in one graph layer, multiple graph layers, or multiple graph windows. If desired, the interactive dialog box can

remain open after plotting, allowing you to add additional data plots to an existing graph window. You can resize the dialog box (by dragging on its edge) to minimize the amount of screen space it occupies.

How to Activate this Method

This plotting method is the Excel default option after installing and starting Origin. If the default options have been altered, re-activate this plotting method by doing one of the following:

If an Excel workbook is active,

1. Select the **Excel** tab on the **Options** dialog box (**Window:Origin Options**).
2. Clear the **Default Plot Assignments** check box.

or, if any other child window is active,

1. Select **Tools:Options**, then click the Excel tab.
2. Clear the **Default Plot Assignments** check box.

What Data Must be Selected for Each Graph Type?

The Select Data for Plotting dialog box opens when you select **Plot:Graph Type** or click a button on the **2D Graphs**, **2D Graphs Extended**, or **3D Graphs** toolbars (assuming the default plotting method is activated as discussed in the previous section "How to Activate this Method").

When plotting using this method, each graph type has particular data requirements. For example, a ternary diagram requires X, Y, and Z data. For a list of the **data requirements** for each graph type, see The Graph: Types.

Creating One Data Plot

To create a single data plot in a new graph window using Origin's interactive plotting dialog box, do the following:

1. With the workbook active, select **Plot:Graph Type** or click the *Graph Type* button on one of the graph toolbars. Selecting the menu command or the toolbar button opens the Select Data for Plotting dialog box.
2. To specify the X values for the data plot, highlight the desired column of data, or a range of the desired column, and click the X button in the Select Data for Plotting dialog box. To plot the Y values versus row number, skip this step.
3. To specify the Y values for the data plot, highlight the desired column of data, or a range of the desired column, and click the Y button in the Select Data for Plotting dialog box. If your graph doesn't require a selection of Z, error bar, label, or legend title values, go to step 6.
4. If the selected graph type requires Z values, highlight the desired column of data, or a range of the desired column, and click the Z button in the Select Data for Plotting dialog box.
5. If the selected graph type requires error bar, label, or legend title values, highlight the desired column of data, or a range of the desired column, and click the respective button in the Select Data for Plotting dialog box.
6. Click **Plot** to create a data plot in a new graph window based on the selections in this dialog box.

To add additional data to an existing graph window using this dialog box, *do not* click **Close** after plotting your data. Leave the dialog box open for future access. Resize the dialog box to minimize its display.

Creating Multiple Data Plots

To create multiple data plots in a new graph window using Origin's interactive plotting dialog box, do the following:

1. With the workbook active, select **Plot:Graph Type** or click the *Graph Type* button on one of the graph toolbars. Both the menu command and the toolbar button open the Select Data for Plotting dialog box.
2. To specify the X values for the data plots, highlight the desired column of data, or a range of the desired column, and click the X button in the Select Data for Plotting dialog box. To plot the Y values for the data plots versus row number, skip this step.
3. To specify the Y values for the data plots, do one of the following, or a combination of the following operations:
 - Highlight multiple Y columns by clicking and dragging through the desired column headings, SHIFT+clicking on a range of columns, or CTRL+clicking on nonadjacent columns.
 - Highlight a range of data in a column by clicking and dragging through the desired cells. CTRL+click to select additional cells.
 - Click the Y button in the Select Data for Plotting dialog box after selecting the data. If your graph doesn't require a selection of error bar, label, or legend title values, go to step 5.
4. If the selected graph type requires error bar, label, or legend title values, highlight the desired column of data, or a range of the desired column, and click the respective button in the Select Data for Plotting dialog box.
5. After making your data selections, select the data plot display method from the **Plot Into** drop-down list:
 - Select **Single Layer** to plot all data sets into a single layer graph.
 - Select **Multiple Layers** to plot each data plot into its own layer in the same graph window.
 - Select **Multiple Pages** to plot each data plot into its own single layer graph window.
6. Click **Plot** to create the graph(s) specified in the **Plot Into** drop-down list.

To add additional data to an existing graph window using this dialog box, *do not* click **Close** after plotting your data. Leave the dialog box open for future access. Resize the dialog box to minimize its display.

Highlighting Data and Using the Default Plot Assignments

This plotting method minimizes the steps required to create a graph from a workbook by allowing you to highlight your workbook data and then select **Plot:Graph Type** or click the *Graph Type* button on the **2D Graphs**, **2D Graphs Extended**, or **3D Graphs** toolbar. The graph is automatically created based on the data selection and Origin's default plot assignments for the selected graph type.

There is no dialog box to serve as an intermediary plotting tool, so this plotting method must make assumptions on the designation (X, Y, etc.) of the highlighted data for a given graph type. These assumptions are discussed below, under "What Data Must be Selected for each Graph Type?"

How to Activate this Method

This plotting method is *not* the default option after installing and starting Origin. To activate this plotting method, do the following:

1. Open the Options dialog box (**Window:Origin Options** when a workbook is active or **Tools:Options** when any other child window is active)
2. Choose the Excel tab and select the **Default Plot Assignments** check box.

This instructs Origin to make the same assumptions regarding column designation, column order, etc. as are made when worksheet data are plotted.

What Data Must be Selected for Each Graph Type?

The data requirements for each of the built-in graph types are listed below. Note that in all cases, when you are advised to select a column of data, you can *alternatively select a range* of a column. Additionally, for some of Origin's graph types, when selecting multiple columns, the use of row numbers for X values can be activated by holding down the CTRL key when selecting **Plot:Graph Type** or when clicking the *Graph Type* button on the **2D Graphs**, **2D Graphs Extended**, or **3D Graphs** toolbar (hold the CTRL key down until the graph is created). When this option is available, the Description field refers to the "CTRL key being depressed."

Origin's Default Plot Assignments Using this Plotting Method



Graph Type	Selected Data Requirements	Description
2 Point segment 2D Waterfall 3D Ribbons 3D Walls 3D Waterfall 3 Point segment 4 Pane 9 Panel Area Bar Column Horizontal 2 panel Horizontal step Line Line+symbol Polar Scatter Spline connected Stack Stack bar Stack column Vertical 2 panel Vertical drop line Vertical step XYY 3D Bars Zoom	One or more columns.	If one column is selected: The column supplies the Y values. The data are plotted versus row number. If more than one column is selected: The leftmost column supplies the X values. All other columns supply the Y values. The data are plotted versus the X values. If more than one column is selected and the CTRL key is depressed: All the columns supply the Y values. The data are plotted versus row number.
Box chart	One or more columns.	Each selected column supplies Y values for a separate box. Column names supply the associated X values.
Double Y Axis	Two or more columns.	If two columns are selected: Both columns supply Y values. The data are plotted versus row number. If three columns are selected: The leftmost column supplies X values. Other columns supply Y values. The data are plotted versus X values.

Graph Type	Selected Data Requirements	Description
Fill area	Two or three columns.	<p>If two columns are selected: Both columns supply Y values. The data are plotted versus row number.</p> <p>If three columns are selected: The leftmost column supplies X values. The other two columns supply Y values. The data are plotted versus X values.</p>
Floating bar Floating column	Two or more columns.	<p>If two columns are selected and the CTRL key is depressed: The leftmost column supplies the starting Y values. The second column supplies the ending Y values. The data are plotted versus row number.</p> <p>If three or more columns are selected: The leftmost column supplies the X values. The second column supplies the starting Y values. The next column supplies the intermediate Y values (etc.). The rightmost column supplies the ending Y values. The data are plotted versus X values.</p> <p>If three or more columns are selected and the CTRL key is depressed: The leftmost column supplies the starting Y values. The next column supplies the intermediate Y values (etc.). The rightmost column supplies the ending Y values. The data are plotted versus row number.</p>
High-Low-Close	Three columns or four columns.	<p>If three columns are selected: The leftmost column supplies the high values, the next column supplies the low values, and the last column supplies the closing values. The data are plotted versus row number.</p> <p>If four columns are selected: The leftmost column supplies the X values. The second column supplies the high values. The third column supplies the low values. The rightmost column supplies the closing values. The data are plotted versus the X values.</p>
Histogram	One or more columns.	A histogram graph is created containing an interlaced histogram for each of the selected columns.
Histogram + Probabilities	One column.	A histogram is created for the selected column. The cumulative counts are also displayed.
Indexed size (Bubble) and color map	Three columns or four columns.	If three columns are selected: The leftmost column supplies the Y values. The second column supplies the size values. The rightmost column supplies the color values. The data is plotted versus row number.



Graph Type	Selected Data Requirements	Description
Indexed size (Bubble) and color map (cont'd)		If four columns are selected: The leftmost column supplies the X values. The second column supplies the Y values. The third column supplies the size values. The rightmost column supplies the color values. The data are plotted versus the X values.
Color map, Indexed size (Bubble)	Two columns or three columns.	If two columns are selected: The leftmost column supplies the Y values. The second column supplies the size or color values. The data are plotted versus row number. If three columns are selected: The leftmost column supplies the X values. The next column supplies the Y values. The rightmost column supplies the size or color values. The data are plotted versus the X values.
Line series	Two or three columns.	If two or three columns are selected: The columns supply the Y values. Each series of row values comprises a line + symbol data plot. The data plot's X values are determined by the selected Y column number (1, 2, or 3). The data plot's Y values are determined by the actual cell values in the selected column.
Pie	One column.	The selected column values are summed, and the percentage of the total is determined for each selected value. The pie chart displays the percentage of the total for each selected value as a pie section.
QC (X bar R)	One or more columns.	If one column is selected: The column supplies the Y values. The X values are determined by the subgroup number (defined by the subgroup size and the number of column values). The data are plotted versus X values. If more than one column is selected: The selected columns supply the Y values. The X values are determined by the row number. The data are plotted versus X values.
Ternary	Three columns.	The leftmost column supplies the X values. The second column supplies the Y values. The rightmost column supplies the Z values. The X, Y, Z data are plotted.
XYAM Vector	Three columns or four columns.	If three columns are selected: The leftmost column supplies the Y values. The second column supplies the angle values. The rightmost column supplies the magnitude values. The data are plotted versus row number.

Graph Type	Selected Data Requirements	Description
XYAM Vector (cont'd)		If four columns are selected: The leftmost column supplies the X values. The second column supplies the Y values. The third column supplies the angle values. The rightmost column supplies the magnitude values. The data are plotted versus the X values.
XXYY Vector	Four columns.	The leftmost column supplies the X start values. The second column supplies the Y start values. The third column supplies the X end values. The rightmost column supplies the Y end values.

Creating a Graph with Error Bars


Origin provides two buttons to plot error bars when plotting workbook data using Origin's default plot assignments, the **Y Error** button  and the **XY Error** button  on the **2D Graphs Extended** toolbar.


To create a graph with Y error bars:

- Highlight *two* workbook columns, or a range from two columns. Hold the CTRL key down and click  on the 2D Graphs Extended toolbar. Origin uses the row index number for X values, the left column for Y values, and the right column for Y error bar values. The data displays as a scatter data plot with Y error bars.
- Highlight *three* workbook columns, or a range from three columns, and click  (do not press CTRL) on the 2D Graphs Extended toolbar. Origin uses the leftmost column for X values, the second column for Y values, and the rightmost column for Y error bar values. The data displays as a scatter data plot with Y error bars.

Note that you can create additional data plots with error bars as long as your highlighted workbook data is set up as X, Y1, Y1err, Y2, Y2err, etc.

To create a graph with X and Y error bars:

- Highlight **four** workbook columns, or a range from four columns, and click  (do not press CTRL) on the 2D Graphs Extended toolbar. Origin uses the leftmost column for X values, the second column for Y values, the third column for X error bar values, and the last column for Y error bar values. The data displays as a scatter data plot with X and Y error bars.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Highlighting and Dragging Data into the Graph Window

This method provides no dialog box to serve as an intermediary plotting tool, therefore this method must make assumptions as to how to treat the highlighted data. Note that the resultant plot type is determined by the **Drag and Drop Plot** drop-down list selection on the **Graph** tab of the **Options** dialog box.

- If one column (or a range from one column) is highlighted, this column supplies the Y values for the data plot. The data are plotted versus *row number*.

- If multiple columns (or a range from multiple columns) are highlighted, the leftmost column supplies the *X values*. All other columns supply the Y values. The data are plotted versus the *X values*.
- If multiple columns (or a range from multiple columns) are highlighted *and* the CTRL key is depressed while dragging the data, all the columns are treated as Y values. The data are plotted versus *row number*.

If the graph window contains multiple layers, dropped data plot in the active graph layer (note that dropping data onto a single layer graph will activate this graph and this layer). If data are dropped onto a layer icon, the data plots in that layer.

This plotting method is available whenever a workbook is active and a graph window is open in the project (excluding minimized and hidden graph windows).

To specify a plot type for your data:

1. Select **Window:Origin Options** when a workbook is active or **Tools:Options** when any other child window is active. This opens the **Options** dialog box.
2. Select the **Drag and Drop Plot type** on the **Graph** tab. Select among the following options:
 - Select **Line**, **Scatter**, or **Line+Symbol**.
 - Select **Current** to use the style of the active graph window template (for example, line or scatter). If you have created a custom template with data plot style holders, Origin will search for the first available style holder. If there are no style holders available, Origin plots using the style of the graph template.

To plot data using the drag and drop method:

1. Select your workbook data.
2. With your mouse, point to the right edge of the selection area.
3. Hold down the left mouse button and drag the highlighted data into the graph window.
4. Release the mouse button.

Adding Data Using the Select Data for Plotting Dialog Box

This method of adding data plots to an existing graph window uses the interactive **Select Data for Plotting** dialog box. Use this dialog box to add one or more data plots to a graph. When adding data to an existing graph window, the data are plotted using the style of the graph template (for example, line or scatter). If you have created a custom template with data plot style holders, Origin will use the first available style holder. If there are no style holders available, Origin plots the data using the style of the graph template.

You can continue to add data to a graph using this dialog box as long as you do not click **Close**. However, if you created a graph using a different plotting method or if you closed the Select Data for Plotting dialog box after creating a graph, then you must manually reopen the dialog box to activate this plotting method.


To reopen the **Select Data for Plotting** dialog box:

1. Clear the **Default Plot Assignments** check box on the **Excel** tab of the **Options** dialog box (**Window:Origin Options** when a workbook is active or **Tools:Options** when any other child window is active).
2. Select **Plot:Graph Type** or click the *Graph Type* button on the 2D Graphs, 2D Graphs Extended, or 3D Graphs toolbar to open the Select Data for Plotting dialog box.



To add data plots to an existing graph window using the Select Data for Plotting dialog box:

1. If the Select Data for Plotting dialog box is *not* already open, open the dialog box by making the workbook window active and selecting **Plot:Graph Type** or by clicking the **Graph Type** button on one of the graph toolbars.

or

1. If the Select Data for Plotting dialog box *is* already open, make the workbook (that contains the data you want to plot) the active window. If this workbook is not the workbook that was active when you opened this dialog box, then the **Change Book** button displays in the Select Data for Plotting dialog box. Click this button to continue.
2. To clear the current data plot associations in the Select Data for Plotting view box, click **Clear**. (You may need to resize the dialog box to access this button.)
3. To specify the X values for the data plot(s), highlight a column of data, or a range of a column, and click the  button. To plot the Y values versus row number, skip this step.
4. To specify the Y values for a single data plot, highlight a column of data, or a range of a column.

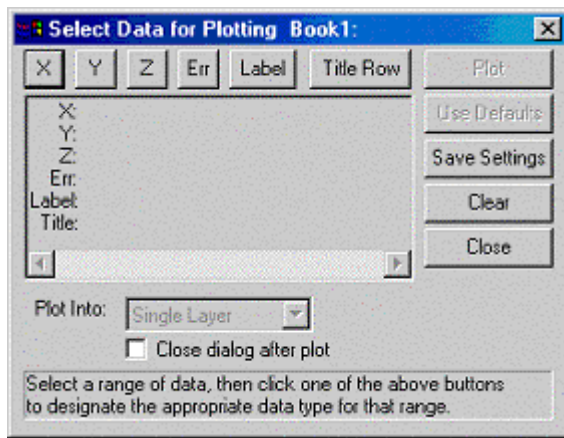
or

4. To specify the Y values for multiple data plots, do *one* of the following, or a combination of the following operations:
 - Highlight multiple Y columns by clicking and dragging through the desired column headings, SHIFT+clicking on a range of columns, or CTRL+clicking on nonadjacent columns.
 - Highlight a range of data in a column by clicking and dragging through the desired cells. CTRL+click to select additional cells.
5. Click the  button after selecting the data.
6. If your graph requires Z values, highlight a column of data, or a range of a column, and click the  button in the Select Data for Plotting dialog box.
7. If your graph requires **Err(or bar)**, **Label**, or legend **Title** (Row) values, highlight the appropriate column(s), or a range from the column(s), and click the appropriate button.
8. Click on your graph window to make it the active (receiving) graph window.
9. Click **Add Plot** to plot the data to the active graph window. If the graph window contains multiple layers, the data plots in the active layer.

Note: Each graph type has specific data requirements (for example, a ternary diagram requires X, Y, and Z data). To learn more, see the specific plot type in the section entitled The Graph: Types.

Reference: Select Data for Plotting Dialog Box

Select Data for Plotting Dialog Box Controls



The Plot Designation Buttons

Assign the selected workbook data to provide:

X: The X values for a single data plot or for multiple data plots.

Y: The Y values for a single data plot or for multiple data plots.

Z: The Z values for a single data plot.

Err: The Y error bar values for a single data plot. The error bars are associated with the first selected Y dataset to the left of the error bar data.

Label: The data label values for a single data plot. The data labels are associated with the first selected Y dataset to the left of the label data.

Title Row: The legend text for the data plot(s). If the Scan Data for Legend check box on the Excel tab of the Options dialog box is selected (**Window:Origin Options** when a workbook is active or **Tools:Options** when any other child window is active), Origin automatically assigns a row number for this designation.

The Data Plot Association View Box

This view box displays the data range selections for the X, Y, etc. values. Except for the **Title** field, the range is displayed using the following syntax:

StartColNameRowNum:EndColNameRowNum.

The **Title** field displays the selected row number only.

The Plot Into Drop-down List

If you assign multiple Y ranges from the workbook, Origin creates multiple data plots using either the selected X data or the associated row numbers. Control the display of the data plots from this drop-down list.

- Select **Single Layer** to plot all data sets into a single layer graph.
- Select **Multiple Layers** to plot each data plot into its own layer in the same graph window.
- Select **Multiple Pages** to plot each data plot into its own single layer graph window.

The Close Dialog After Plot Check Box

Select this check box to close the dialog box after clicking **Plot**.

If this check box is cleared, the dialog box remains open and available when a workbook or a graph window is active. Edit the dialog box to add additional data plots to the graph, or to create new graphs from the workbook data. Resize the dialog box to minimize the amount of screen space it occupies.

The Plot Button

Click this button to create one or more data plots based on the selection in the data plot association view box. *The data plots using the graph type that was selected when the dialog box first opened.*

The Change Book Button

If you change workbooks after this dialog box is open, the **Plot** button is replaced by the **Change Book** button. Click this button to enable selection of data sets in the currently active workbook. After clicking this button, the button is replaced by the **Plot** button.

The Add Plot Button

When the graph window is active, the **Plot** button is replaced by the **Add Plot** button. Click this button to add the current data selection in the Select Data for Plotting dialog box to the graph.

To use this button effectively, first redirect window activity to the workbook window. Create the new data plot association(s) by selecting data and clicking the plot designation buttons. Then redirect window activity back to the graph window. Click the **Add Plot** button to add the data plot(s) to the active graph layer.

The Use Defaults Button

This button is only available when data is highlighted in the workbook before you select **Plot:Graph Type** or click the **Graph Type** button on one of the graph toolbars. Additionally, if the previous condition is met, this button is only active when you first open the dialog box.

Click this button to plot the highlighted workbook data using Origin's default plot assignments for the selected graph type instead of establishing plot associations in the dialog box.

After clicking the button, an Attention dialog box prompts to select the Default Plot Assignments check box on the **Excel** tab of the **Options** dialog box (**Window:Origin Options** when a workbook is active or **Tools:Options** when any other child window is active).

- Click **Yes** to create the data plots from the highlighted workbook data and change the check box status.
- Click **No** to create the data plots but leave the check box status unchanged.

The Save Settings Button

Click this button to save the selection from the **Plot Into** drop-down list for future instances of this dialog box in the current Origin session.

The Clear Button

Click this button to clear the current selection in the data plot association view box.

The Close Button

Click this button to close the dialog box without creating a data plot.

Managing Projects that Include Workbooks

Saving the Project with Links to External Excel Workbook Files

To link the active workbook to your Origin project file:

1. Right-click on the workbook window title bar and select **Properties** from the shortcut menu. This opens the **Workbook Properties** dialog box.
2. Select the **External** radio button in the **Save As** group.

Origin displays the full path and file name of the linked source Excel file in the **File Name** group. If the workbook window was created in Origin, the default path is determined by the Excel path specified on the File Location tab of the Options dialog box (**Window:Origin Options** when a workbook is active, or **Tools:Options** when any other child window is active).

Updating the Linked Source Excel Files

To ensure that changes made to an external Excel workbook in Origin are reflected in the source workbook file, you can manually re-save the workbook to the source file name, or you can automatically update the source file when you save your Origin project.

- To manually re-save the workbook to the source Excel file:
 1. Right-click on the workbook window title bar and select **Save Workbook As** from the shortcut menu.
- To automatically update the source Excel file when saving your project:
 1. Right-click on the workbook window title bar and select **Properties** from the shortcut menu. This opens the **Workbook Properties** dialog box.
 2. Select the **Update Automatically** check box in the **Save As** group and click **OK**.

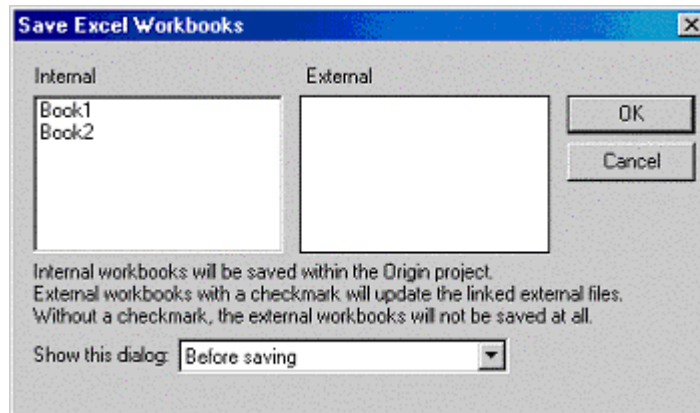
When you select **File:Save Project** or **File:Save Project As**, or when you click the **Save Project** button on the Standard toolbar, Origin will automatically update the source Excel file.

If you have selected either **Before Saving** or **Before Save Project As** from the **Saving Excel Workbooks** drop-down list on the **Excel** tab of the **Options** dialog box (**Window:Origin Options** when a workbook is active, or **Tools:Options** when any other child window is active), then the **Save Excel Workbooks** dialog box opens after selecting one of the project saving options. To update the source Excel file, the associated check box must be selected from the **External** list box.

See, the topic *Reference: Save Excel Workbooks dialog box* on page 461.

Reference: Save Excel Workbooks Dialog Box

Save Excel Workbooks Dialog Box Controls



The Internal List Box

This list box displays the workbooks in which the **Internal** radio button was selected from the associated **Workbook Properties** dialog box. These workbooks are saved as part of the Origin project file, *not* as an Excel file with a link to the project.

Note: All workbooks created by clicking the **New Excel** button  on the Standard toolbar have the **Internal** radio button selected by default.


The External List Box

This list box displays the workbooks in which the **External** radio button was selected from the associated **Workbook Properties** dialog box. These workbooks *are* saved as a separate Excel file, with a link to the project.

If the check box next to the workbook is selected, then the source Excel file is updated when the project is saved. To ensure that this check box is selected by default, select the **Update Automatically** check box in the workbook's associated **Workbook Properties** dialog box.

The Show this Dialog Drop-down List

This drop-down list controls the display of this dialog box when you save a project that contains a workbook.

- Select **Never** to prevent Origin from opening this dialog box under all circumstances.
To re-enable the display of this dialog box, select either **Before Saving** or **Before Save Project As** from the **Saving Excel Workbooks** drop-down list on the **Excel** tab of the **Options** dialog box (**Window:Origin Options** when a workbook is active, or **Tools:Options** when any other child window is active).
- Select **Before Saving** to direct Origin to open this dialog box whenever you select **File:Save Project** (or whenever you click the **Save** button  on the Standard toolbar), assuming the project includes an Excel workbook.
- Select **Before Saving Project As** to direct Origin to open this dialog box whenever you select **File:Save Project As**, assuming the project includes an Excel workbook.

Establishing Links if You Created the Workbook in Origin

When you click the **New Workbook** button on the Standard toolbar to open a new workbook in Origin, the **Internal** radio button is selected by default in the workbook's **Workbook Properties** dialog box.

To change the workbook's status to external, do one of the following:

- Right-click on the workbook window title bar and select **Properties** from the shortcut menu. This menu command opens the **Workbook Properties** dialog box. Select the **External** radio button and click **OK**.
- Right-click on the workbook window title bar and select **Save Workbook As** from the shortcut menu. This menu command opens the **Save As** dialog box. Type a file name in the associated text box and click **OK**.

Now when you save your project, a link is saved to the source (external) Excel workbook file.


Saving the Project with Internal Excel Workbooks

To ensure that the active workbook is saved internal to the current project when the project is saved:

1. Right-click on the workbook window title bar.
2. Select **Properties** from the shortcut menu.

This shortcut menu command opens the **Workbook Properties** dialog box. Select the **Internal** radio button in the **Save As** group.

After changing the status of a workbook from external to internal, Origin *will not update* the original source Excel file when you select **File:Save Project** or **File:Save Project As**, or when you click the **Save Project**

button  on the Standard toolbar. Additionally, any new changes made to the original source Excel file are not reflected in the project.

Opening an Origin Project that has Links to External Excel Workbooks

When you open a project that includes links to external Excel file(s), Origin opens those workbook(s) in the project. If Origin can't find the Excel file at the location specified in the **Linked File Path** field of the workbook's **Workbook Properties** dialog box, then Origin opens the **File Name** dialog box:

1. Type the correct external file path and file name in this dialog box and click **OK**.

If the Excel file isn't available:

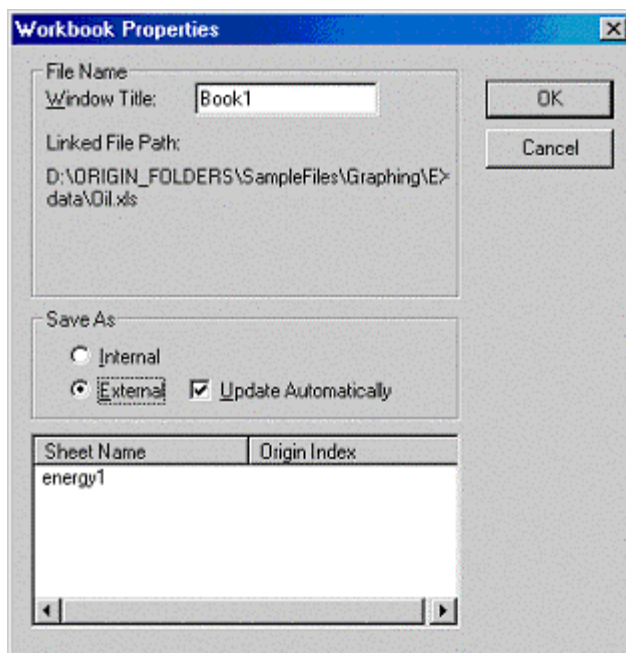
1. Click **Ignore** (or **Ignore All**). In such cases, Origin opens the project and displays a placeholder for each workbook whose source *wasn't* available. Additionally, data plots created from the missing workbook(s) are not displayed in the graph window(s).

Opening an Origin Project that Contains Internal Excel Workbooks

When you open a project that includes internal Excel file(s), Origin displays the Excel workbook(s) as they were saved with the project.

Reference: The Workbook Properties Dialog Box

Workbook Properties Dialog Box Controls



The File Name Group

Type the desired workbook window name in the **Window Title** text box.

When the **External** radio button is selected (in the **Save As** group), Origin displays the full path and file name of the linked source file in the **Linked File Path** field.

The Save As Group

Select the **Internal** radio button to save the active workbook internal to the project when the project is saved. When this radio button is selected and the project is saved, changes made to the workbook in Origin are *not* reflected in the original source workbook. Conversely, changes made to the original source workbook file are not reflected in the Origin project.

Select the **External** radio button to save a link to the active workbook when the project is saved. When this radio button is selected and the project is saved, changes made to the workbook in Origin are reflected in the original source workbook. Additionally, changes made to the original source workbook file are reflected in the Origin project.

Select the **Update Automatically** check box to automatically update existing links between the workbook display in Origin and the original source workbook when the project is saved. This check box is only available when the **External** radio button is selected. If this check box is cleared, changes made to the workbook in Origin are not reflected in the source workbook file. Additionally, when the project is re-opened, the workbook changes are not included.

The Sheet Name - Origin Index List Box

When plotting workbook data from multiple sheets, Origin uses an *@SheetNumber* notation to denote the sheets that contain plotted data. To determine the numeric value of *SheetNumber*, Origin numbers the sheets in the order in which they are accessed for plotting. The workbook sheets and their associated *SheetNumber* values are listed in this list box.

Troubleshooting Problems Using Excel in Origin

If Excel Doesn't Close When You Exit Origin

If you are working with an Origin project that includes Excel workbooks, Origin closes Excel when you close Origin or when you close the project that includes the workbooks.

If Origin fails to properly close Excel, you must close Excel manually. To accomplish this, press CTRL+ALT+DELETE. This action opens the **Close Program** dialog box (On Windows 2000 systems, this action opens the **Windows Security** dialog box. Choose **Task Manager**). Select **Excel (Excel.exe)** from the list box and click the **End Task (End Process)** button.

If One of the Windows has a Blank Display

Occasionally, the workbook window, or other windows containing workbook data, may become inactive. This condition is apparent when the window containing workbook data is blank. To reactivate the window and restore its display:

1. Right-click on the workbook window title bar and select **Update Origin** from the shortcut menu.

If Excel Fails to Launch from Within Origin

In certain instances, Excel may fail to launch from within Origin. In most cases, this is due to a problem with the Excel registration entry in Windows. To rectify this problem, Excel must be un-installed and then re-installed.

For a complete discussion of this issue, go to the **Online Technical Support Center** on OriginLab's website (www.originlab.com) and search on Keyword(s) **Excel fails to open**.

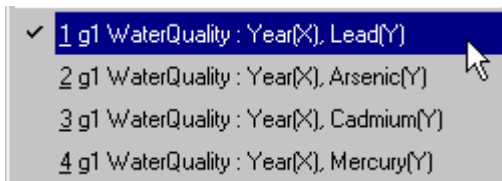
Analysis: Basics

Data: Selecting and Excluding

Selecting the Active Data Plot for Analysis

When performing analysis on a data plot in a graph window, you must make the data plot you want to analyze the *active* data plot. To make a data plot active:

1. Select the data plot from the data list at the bottom of the **Data** menu.



The data list includes all data plots in the active layer. The currently active data plot is checked.

Note: Numerous analysis menu commands and tool functions, when applied to a data plot, will also make changes to the associated worksheet or worksheet data (for example, **Analysis:Subtract** and **Analysis:Smoothing**).

Setting the Worksheet Display Range

Origin provides an option to modify the display range of the worksheet *without* deleting the hidden (excluded) cells and cell values. Once the display range has been modified, plotting and analysis operations act *only on the visible data*.

Setting the Beginning of the Display Range

To set the beginning of the display range:

1. Select a cell, a range of cells, or a worksheet row, and select **Edit:Set As Begin** or right-click and select **Set As Begin** from the shortcut menu.

Values in the cells above the selected cells are hidden from view; they are not deleted.

Setting the End of the Display Range

To set the end of the display range:

1. Select a cell, a range of cells, or a worksheet row, and select **Edit:Set As End** or right-click and select **Set As End** from the shortcut menu.

Values in the cells below the selected cells are hidden from view; they are not deleted.

Resetting to Full Range

To reset the display range back to the full worksheet range:

1. Highlight the affected columns.
2. From the menu, select **Edit:Reset to Full Range**.

Setting the Data Plot's Display Range

There are several ways to change the graph's display range, without altering the axis scale values:

- Alter the display range of the data sets in the associated worksheet.

Note that changing the display range in the worksheet *affects all current and future plot instances*.

To set the beginning of the display range:

1. Select a cell, a range of cells, or a worksheet row, and select **Edit:Set As Begin** or right-click and select **Set As Begin** from the shortcut menu.

Values in the cells above the selected cells are hidden from view; *they are not deleted*.

To set the end of the display range:

2. Select a cell, a range of cells, or a worksheet row, and select **Edit:Set As End** or right-click and select **Set As End** from the shortcut menu.

Values in the cells below the selected cells are hidden from view; *they are not deleted*.

To reset the display range back to the full worksheet range:

1. Highlight the affected columns.
2. From the menu, select **Edit:Reset to Full Range**.

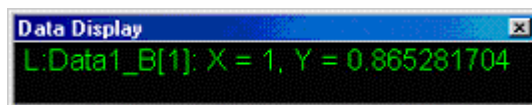
- Alter the display range of the active data plot graphically, using the **Data Selector** tool from the Tools toolbar.

This method does *not* affect the worksheet display range and, therefore, does not affect other plot instances of the data sets.

To set the display range with the Data Selector tool:

1. Right-click on the data plot whose range you want to edit and select **Set as Active** from the shortcut menu. If this command is not available, the data plot is already active.

2. Click on the **Data Selector** tool  in the Tools toolbar. Data markers appear at both ends of the active data plot. The **Data Display** tool also opens.



3. To mark the data segment of interest, click and drag the two markers along the X axis with the mouse. Release the mouse button when the marker displays at the desired data point.

Alternatively, use the ← and → keys to select a marker. The CTRL + ← (or →) keys move the selected marker to the next data point.

4. Do one of the following after you have positioned the data markers to enclose the data segment of interest:
 - Double-click within the selected range in the graph layer.
 - Press ENTER.

- Click on the **Pointer** tool  in the Tools toolbar.
- Press ESC.

5. To complete the operation and set the display range for the data plot, select **Data:Set Display Range** from the Origin menu

or

5. Right-click and select **Set Display Range** from the shortcut menu.

To reset the display range of the data plot back to the original range:

1. From the menu, select **Data:Reset to Full Range**

or

1. Right-click and select **Reset to Full Range** from the data plot's shortcut menu.

- Alter the display range of a data plot by specifying the starting and ending worksheet row numbers.

This method does *not* affect the worksheet display range and, therefore, does not affect the other plot instances of the data sets.

- To access this option from the data plot's shortcut menu:

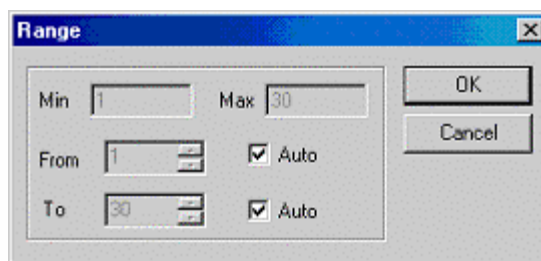
1. Right-click on the data plot whose range you want to edit and select **Edit Range**.

- To access this option from the **Layer n** dialog box:

1. ALT + double-click on the layer icon that includes the data plot whose range you want to edit. This action opens the **Layer n** dialog box.
2. Select the data plot (the primary data set) from the **Layer Contents** list and click **Edit Range**. (Note: If the data plot is part of a data plot group, you cannot click the Edit Range button without first *ungrouping* the data sets. To avoid ungrouping, edit the data plot's range using the shortcut menu command (see next).

Both actions open the **(Plot) Range** dialog box.

Plot Range Dialog Box Controls



The **Min** and **Max** view boxes list the number of rows in the source worksheet. These boxes are not editable.

To alter the data plot's display range, clear the **Auto** check boxes (as needed) and edit the **From** and **To** values.

Note: To reset the display range of the data plot back to the original range, select **Data:Reset to Full Range** from the Origin menu, or right-click on the data plot and select **Reset to Full Range**.

This method can also be invoked through the **Plot Setup** dialog box (see next).

- Alter the **Range** in the **Plot Setup** dialog box *without* checking **Rescale**.

For information on this option, see *Plot Setup: Editing the Plot's Display Range* on page 153.

Extracting Data from the Worksheet

A Note About the Row Number [i]

In the Set Column Values and the Extract Worksheet Data dialog boxes, columns are specified using the **col()** function or the **WorksheetName_ColumnName** notation. The row numbers of a worksheet are specified using the variable **i**.

If **i** is not used in the expression, Origin assumes that the same **i** is used for all the columns involved in the given expression.

For example:

col(C)=col(A)-col(B)

is interpreted as:

col(C)[i]=col(A)[i]-col(B)[i]

where the notation **col(C)[i]** refers to the i^{th} row of column C, and the equation is repeated for all rows in the given range.

If **i** is used explicitly in the expression, the assumption of a common **i** is overridden.

For example:

col(C)=col(B)[i+1]-col(B)[i]

calculates the increment between each row in column B, and puts this value into column C. The equation is repeated for all rows in the given range.

Masking Data from Analysis



The **Mask** toolbar (**View:Toolbars**) allows you to exclude ranges of data or individual data points from analysis. It is most useful if you want to analyze only a specific section of your data, or if you have erroneous data points that you do not want included in your analysis. The Mask toolbar is available for both worksheet and graph windows.


To Mask Data in a Worksheet

1. When a worksheet is active, select a range of data or a single cell and click the **Mask Range**

button

The cell color will change to red and indicating that the data point is masked. The masked data will not be included in any fitting or analysis you do to your data.

Once the data is masked, you can change the color of the masked cells by clicking the **Mask**


Color button . Each time you click this button the mask color increments through the colors in the color palette.

To toggle masking on and off, click the **Disable/Enable Masking** button .

To Mask Data in a Graph

When a graph is active, you can mask a range of data or a single data point.


To mask a single data point:

1. Click the **Mask Point Toggle** button . This action activates the **Data Reader** tool.
2. Double-click on the data point that you want to mask. The Data Reader tool closes and the data point changes color to red and is masked.


To unmask a data point:

1. Click the **Mask Point Toggle** button once more, then double-click on the desired data point.


To mask a range of data in a graph:


1. Click the **Mask Range** button . Data markers display on both ends of the active data plot.
2. Drag the markers to select the desired data range and then press ENTER.

Once the data is masked, you can change the color of the masked cells by clicking the **Mask**

Color button . Each time you click this button the color mask increments through the colors in the color palette.

To unmask a range of data points:

1. Click the **Unmask Range** button . You can now select a range to unmask (not necessarily the same range you masked).

The **Swap Mask** button  removes the masking from the masked data and applies it to the unmasked data.

The **Hide/Show Masked Points** button  toggles the display of the masked points in the graph.

The **Disable/Enable Masking** button  toggles the masking on and off.

Note: The following **Analysis** menu commands are *not* affected by masking data (masking is ignored):

- >> Simple Math
 - >> FFT Filtering
 - >> Translate Horizontal/Vertical
 - >> Subtract Reference Data or Straight Line (graph is active).
-

To learn more about masking data, review the DATA MASKING.OPJ project located in your Origin \SAMPLES\ANALYSIS\DATA MASKING folder.

Math Operations on Worksheet Data

Sorting Data

You can sort individual columns, multiple columns, a range of worksheet data, or an entire worksheet. Origin offers simple sorting as well as nested sorting:

- Simple Sorting

In simple sorting, the specified data is sorted using one "sort by" column and a selected sort order.

To perform a simple sort of the selected data:

1. From the menu, select **Analysis:Sort Columns**.
2. Specify **Ascending** or **Descending** from the associated submenu.

If you have highlighted a range of worksheet columns, or a range of values in multiple columns, Origin sorts only the selected data based on the leftmost selected data set and the chosen sort order. If you have highlighted one column, or a range from one column, Origin sorts only the selected data. Note that if you highlight a range of rows, and not the entire column(s), the sort menu command which is enabled will be **Analysis:Sort Range**.

To perform a simple sort on the entire worksheet:

1. Select **Analysis:Sort Worksheet**.
2. Specify **Ascending** or **Descending** from the associated submenu.

Origin sorts the entire worksheet based on the leftmost selected column or the leftmost range of selected values in the worksheet and the chosen sort order. If no columns or values are selected, then Origin sorts the entire worksheet based on the leftmost column of the worksheet.

- Nested Sorting

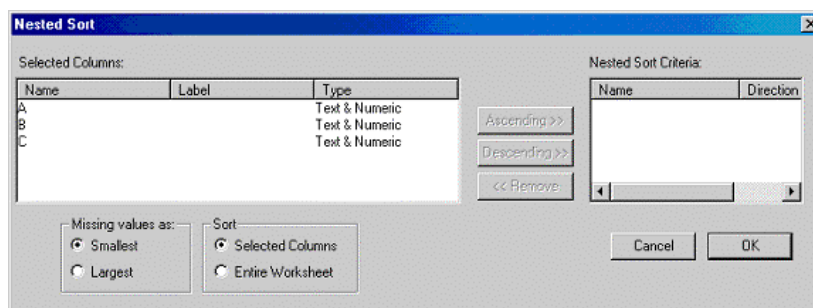
To perform a nested sort on the selected data:

1. Select **Analysis:Sort Columns:Custom**
- or
1. Click the **Sort** button on the Worksheet Data toolbar.

To perform a nested sort on the entire worksheet:


1. Select **Analysis:Sort Worksheet:Custom**
- or
1. Select the entire worksheet and click the **Sort** button.

The Nested Sort Dialog Box



Select the column for the primary sort from the **Selected Columns** list box and click the **Ascending** or **Descending** button. Then select the column for the secondary sort from the **Selected Columns** list box and click the **Ascending** or **Descending** button. Select additional columns as needed.

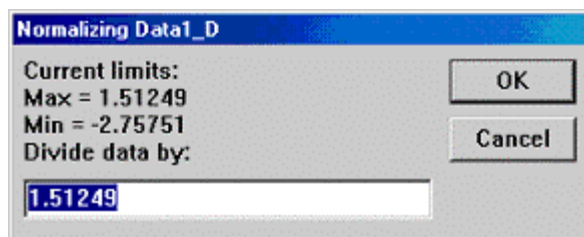
After clicking **OK**, Origin sorts the selected data so that the primary column is in ascending or descending order, as specified. If there are multiple rows with the same value in the primary column, the values in the corresponding rows of the secondary column, and the sort order chosen for the secondary column, are used to determine the ordering. This nesting process is continued down to the last column in the **Nested Sort Criteria** list box.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Normalizing Data

To normalize a data set or a range of values in a data set:


1. Highlight the desired column.
2. Select **Analysis:Normalize**.



This menu command opens the **Normalizing Dataset** dialog box. The dialog box displays minima and maxima for the selected range of values, and provides a text box to enter a factor value.

3. Accept or enter a factor value and click **OK**.

Origin divides all values in the selected range by the factor value.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Date and Time Math Operations

Dates and Time:

If you create a worksheet with column A containing **Date** values and column B containing some measured values, you could create a third column (C) which contained the elapsed **Time** between each element (row) by using the following formula for column C in the Set Column Values dialog box:

`col(A)[i]-col(A)[i-1]` (for i = 2 to last row of A)

If you convert the elapsed **Time** column to a **Numeric** column, the elapsed time values will represent the number of days (for example...).

using 1 day = 24 hours = 1440 minutes = 86400 seconds, then 30.2765 days would be 30 days, 6 hours, 38 minutes and 9.6 seconds.

Month:

Months are enumerated from January (1) to December (12). Numbers greater than 12 are handled by a modulus function when converted to **Month**, for example...

46 is converted to October because **mod(46,12)** is 10, and 10 is October (December = 0). However, you cannot *type* values outside the range 1 to 12 into a cell in a Month column. If you do so, Origin displays a missing value in the cell.

Day:

Days are enumerated from Sunday (0) to Saturday (6). Numbers greater than 6 are handled by a modulus function when converted to **Day**, for example...

46 is converted to Thursday because **mod(46,7)** is 4, and 4 is Thursday. However, you cannot type values outside the range 0 to 6 into a cell in a Day column. If you do so, Origin displays a missing value in the cell.

Performing Calculations on Data Sets Using LabTalk

You can use LabTalk to perform calculations on data sets, either performing the calculations row by row, or using linear interpolation if the data sets have different numbers of elements. In this case of differing numbers of elements, use of linear interpolation is dependent on your LabTalk notation.

Row by Row Calculations

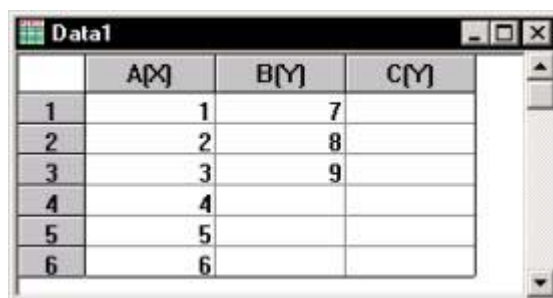
Vector calculations are always performed row by row when you use the general notation:

`data set = scalar operator data set`

or

`data set = data setoperatordata set`

This is the case even if the data sets have different numbers of elements. For example, if you start with the following worksheet:



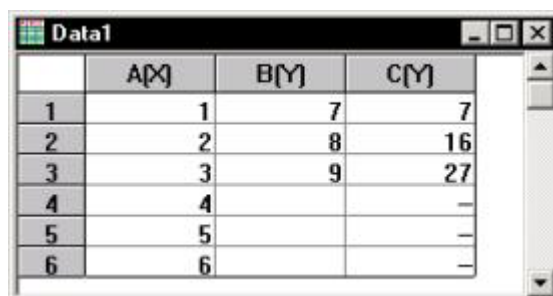
	A[X]	B[Y]	C[Y]
1	1	7	
2	2	8	
3	3	9	
4	4		
5	5		
6	6		

And then type the following LabTalk script in the Script window (**Window:Script Window**):

```
data1_C = data1_A * data1_B    (press ENTER)
```

The elements of **data1_A** are multiplied by the corresponding elements of **data1_B** and the product of each multiplication is put in the corresponding rows of the **data1_C** data set.

The resultant worksheet displays as follows:



	A[X]	B[Y]	C[Y]
1	1	7	7
2	2	8	16
3	3	9	27
4	4		—
5	5		—
6	6		—

An example of a vector calculation involving a scalar follows. You can also execute this LabTalk script in the Script window:

```
data1_b = 3 * data1_a    (press ENTER)
```

In this example, every element of the **data1_a** data set is multiplied by 3. The results are put into the corresponding rows of the **data1_b** data set.

If you were to instead execute the following script (assuming **newData** does not previously exist) in the Script window:

```
newData = 3 * data1_A    (press ENTER)
```

then a temporary data set called **newData** is created and assigned the result of the vector operation. Elements of the temporary data set can be accessed in the same way you would access an element of a data set contained in a worksheet.

Calculations Using Interpolation

When you use one of the following notations to perform vector operations:

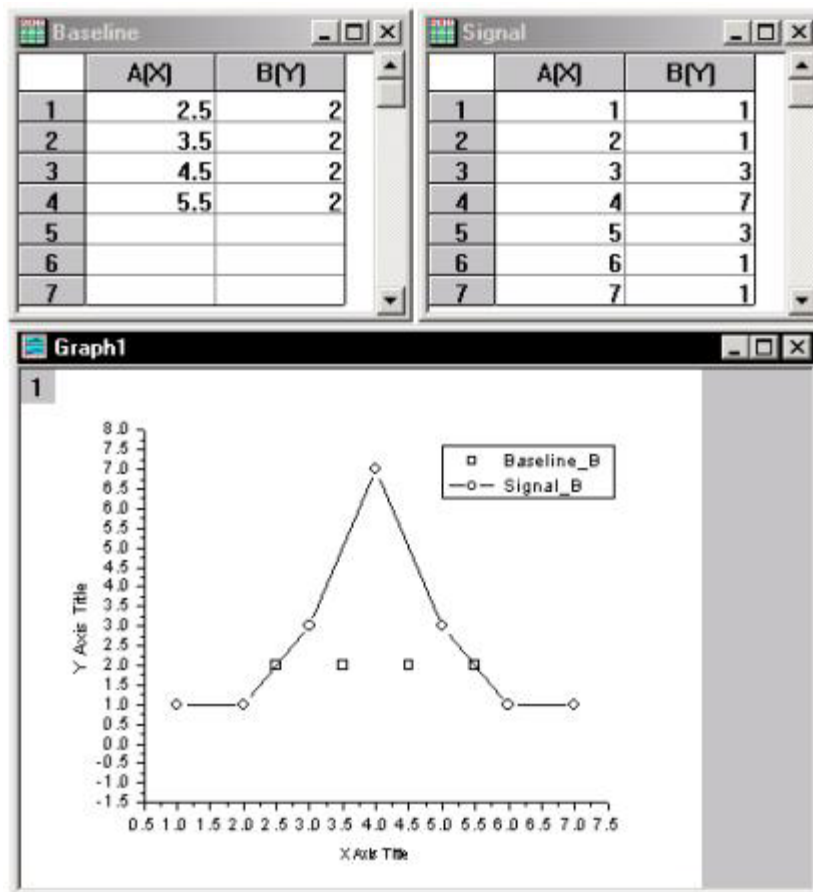
data set = scalaroperatordata set

or

data set = data setoperatordata set

row by row calculations are performed even if the data sets have different numbers of elements. However, there may be times when you want to use linear interpolation when performing calculations on data sets of different sizes.

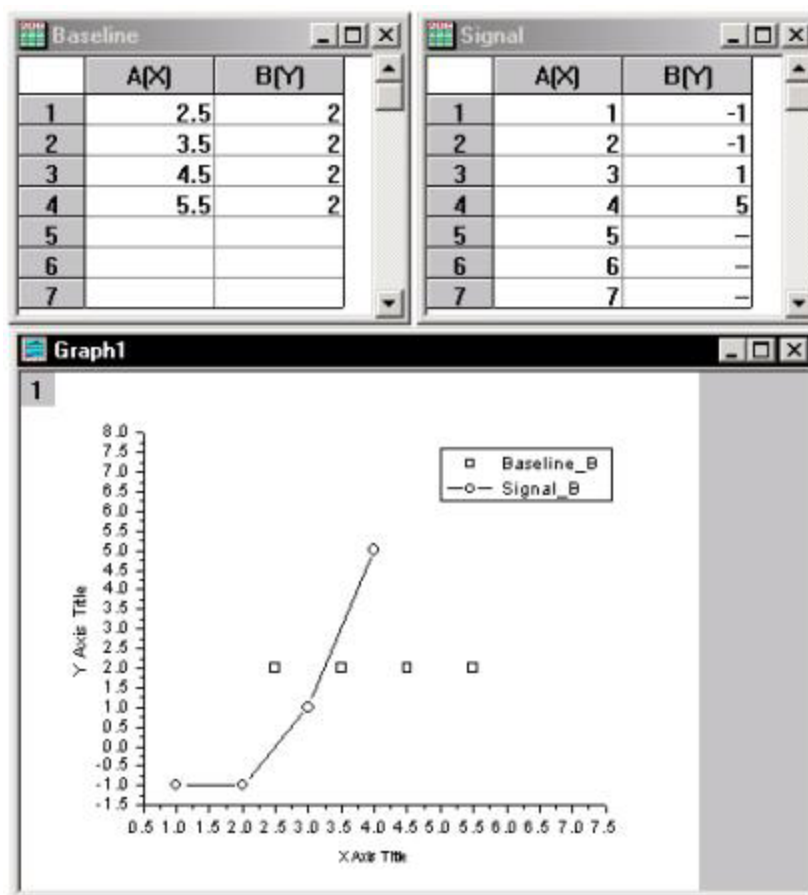
As an example, consider the following two dependent data sets, each with its own set of independent data:



If you were to subtract **baseline_b** from **signal_b** by entering the following script in the Script window:

```
signal_b -= baseline_b    (press ENTER)
```

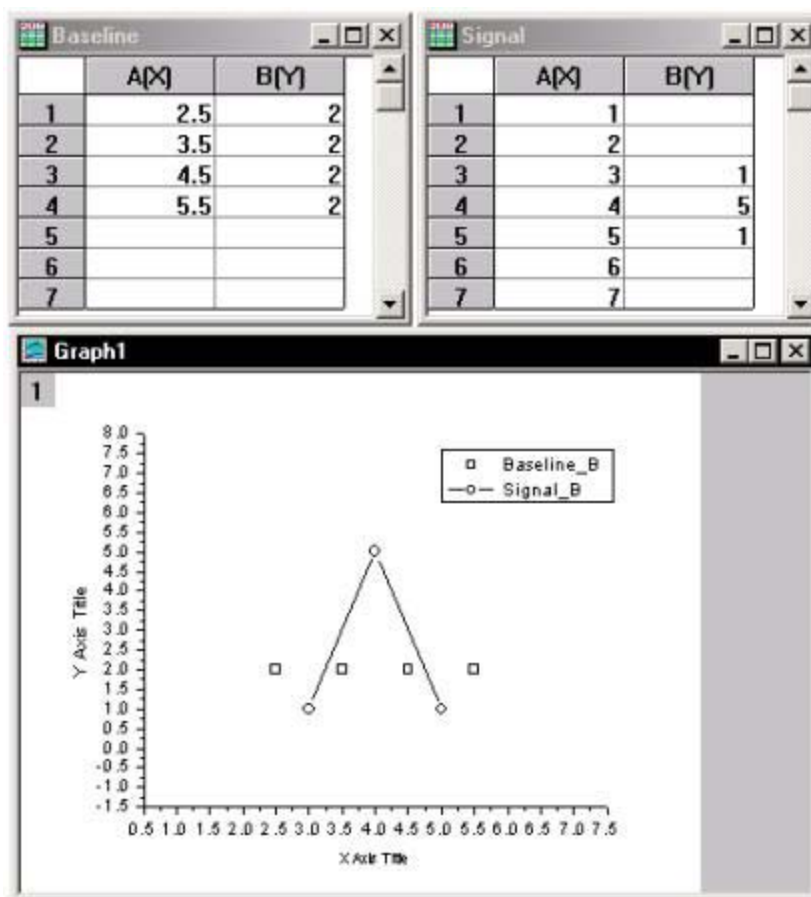
then the subtraction would be performed row by row (with no linear interpolation) as follows:



However, if you use a **data set operator data set** assignment-operation statement (starting with the initial worksheet values) in the Script window:

```
signal_b - baseline_b (press ENTER)
```

then linear interpolation of the second data set (**baseline_b**) within the domain of the first data set (**signal_b**) is used to carry out the subtraction. The results are stored in the first data set (**signal_b**). The [following figure](#) shows the results of this calculation, when starting with the initial worksheet values.



In this example, interpolation was used to find the Y values of **baseline_b** using the X values given by **signal_a** within the X domain of **baseline_b**.

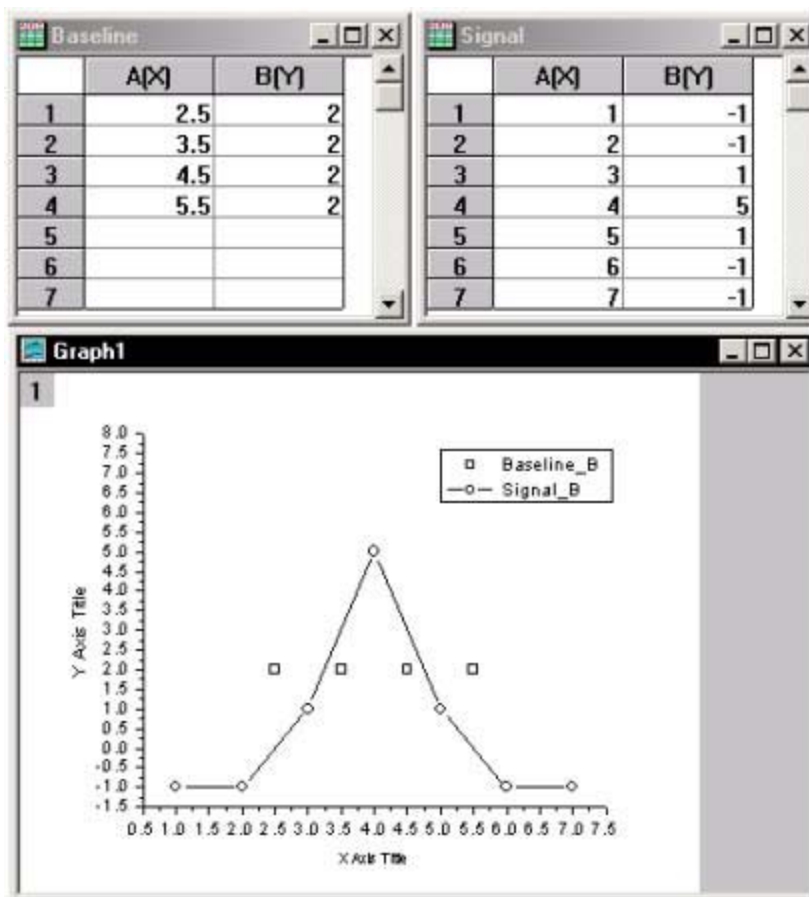
In order to have Origin perform the interpolation *outside the domain* of the second data set (in this case, **baseline_b**) for all X values of the first data set, you need to specify an option switch (-O). The syntax using this option switch is:

```
data setoperator-O data set
```

Thus, in this example, you would enter the following script in the Script window:

```
signal_b --O baseline_b (press ENTER)
```

The following figure shows the results of this calculation, when starting with the initial worksheet values.



In this example, the option switch caused linear interpolation of **baseline_b** to be used within and outside of its domain in order to perform the calculation for the entire domain of **signal_b**.

In addition to using the subtraction operator with the `-O` option, you can use the addition (+), multiplication (*), division (/), and exponentiate (^) operators with `-O`.

Note: When data is unsorted or there are duplicate Y values for any given X value, there will be inconsistencies in the linear interpolation results.

For more information on LabTalk, see the LabTalk Language Reference section of the Programming Help file (**Help:Programming**).

Math Operations on Plotted Data

Subtracting a Straight Line

This feature is only available when a graph is active.

To define a straight line, then subtract that line from the active data plot:

1. Select **Analysis:Subtract Straight Line**.

When this menu command is selected, the cursor changes to a cross-hair symbol (the **Screen Reader** tool) and the **Data Display** tool opens if it is not already open.

- Click in the graph window to view the XY coordinates of the selected location in the **Data Display** tool.
- Double-click at the desired location to set the endpoints of the line.

Origin subtracts the line you have drawn from the active data plot and plots the result. Because this menu command changes the Y data set in the worksheet, *it affects all plot instances of the data set.*

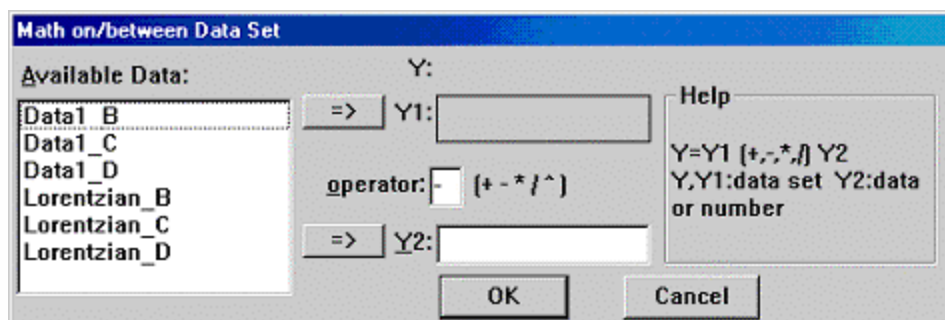
Subtracting Reference Data

This feature is only available when a graph is active.

To subtract one data plot from another:

- Select **Analysis:Subtract:Reference Data**.

This menu command opens the **Math on/between Data Set** dialog box with the (-) operator selected in the **Operator** text box.



Select and move the desired data sets into the Y1 and Y2 text boxes using the => buttons. If the X values of the two data sets do not match, interpolation is automatically performed on the reference data. Because this menu command changes the Y data set in the worksheet, *it affects all plot instances of the data set.*

Performing Math Operations

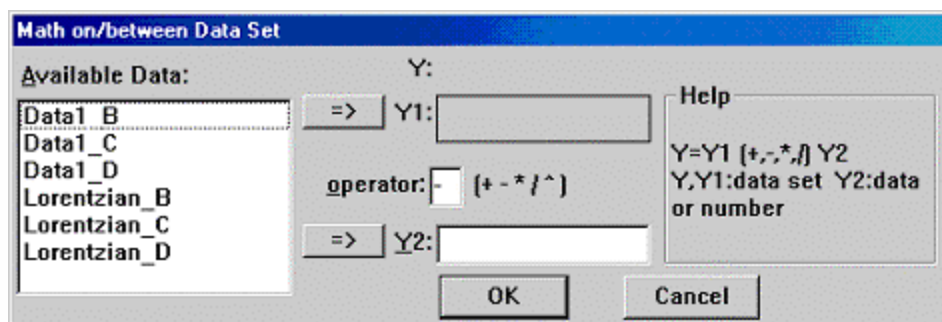
To perform a math operation on or between two data sets:

Select **Analysis:Simple Math**. This menu command opens the **Math on/between Data Set** dialog box.

Note that the **Analysis:Simple Math** menu command is only available when a graph window is active. When the worksheet is active, similar results can be obtained by selecting **Column:Set Column Values**.

Note: The Simple Math operations will modify worksheet data sets. Additionally, the X data set(s) should be sorted before performing Simple Math operations.

The Math on/between Dataset Dialog Box



To perform a math operation

1. Click to select the desired data set from the **Available Data** list box.
2. Click the upper => button to display this data set in the **Y1** text box.
3. Type a numerical value, a variable, a data set, or an equation in the **Y2** text box. To display a data set in this text box, select the data set from the **Available Data** list box and click the lower => button.
4. Type an arithmetic operator in the **Operator** text box.
5. Click **OK** to perform the math operation.

For example, if you add the **Data1_B** data set into the Y1 text box, the **Data1_C** data set into the Y2 text box, and a subtraction operator (-) in the Operator text box, Origin subtracts each value in **Data1_C** from the corresponding value in **Data1_B** and saves and plots the result as **Data1_B** after clicking OK.

You can also type a numerical constant for the Y2 value. For example, if Y2=35 and the operator is a minus sign (-), then Origin subtracts 35 from each value in the Y1 data set and plots the result after clicking OK.

Note: If the X coordinate points of Y2 do not correspond to the X coordinate points of Y1, Y2 is interpolated or extrapolated for each point in Y1. The interpolation or extrapolation depends on the line connection type for the Y2 data plot. For example, if the line connection type is spline, the interpolation is a spline interpolation.

Horizontal and Vertical Translation

The Horizontal and Vertical translation menu commands are only available when a graph is active.

Horizontal Translation

To move the entire active data plot horizontally along the X axis:

1. Select **Analysis:Translate:Horizontal**.

This menu command opens the **Data Display** tool if it is not already open.

2. Double-click on the data plot (or click and press ENTER) to choose the initial data point. The XY coordinates of the data point display in the **Data Display** tool.
3. Double-click again at any point on the page.

Origin calculates the difference in X between the two selected X-coordinates and adds this amount to the entire active data plot. Because this menu command changes the X data set in the worksheet, it affects all plot instances of the data set.

Vertical Translation

To move the entire active data plot vertically along the Y axis:

1. Select **Analysis:Translate:Vertical**.

This menu command opens the **Data Display** tool if it is not already open.

2. Double-click on the data plot (or click and press ENTER) to choose the initial data point. The XY coordinates of the data point display in the **Data Display** tool.
3. Double-click again at any point on the page.

Origin calculates the difference in Y between the two selected Y-coordinates and adds this amount to the entire active data plot. Because this menu command changes the Y data set in the worksheet, it affects all plot instances of the data set.

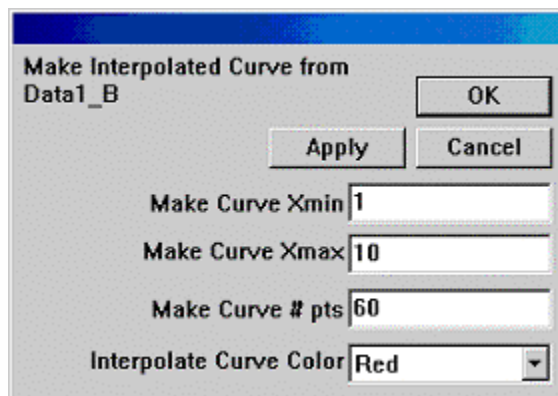
Interpolating and Extrapolating

This feature is only available when a graph is active.

To interpolate or extrapolate between the data points of the active data plot:

1. Select **Analysis:Inter/Extrapolate**.

The menu command opens the **Make Interpolated Curve from Dataset** dialog box.



2. Type the minimum and maximum values to set the length of the interpolated or extrapolated data plot in the **Make Curve Xmin** and **Make Curve Xmax** text boxes. You are not limited to the original length.
3. Specify the number of points to draw in the interpolated or extrapolated data plot in the **Make Curve # Points** text box.
4. Click **Apply** to view the interpolated or extrapolated data plot based on the current settings including the specified **Interpolate Curve Color**.

The dialog box remains open and is available for further changes. Each time you change a setting and click **Apply**, the results update in the graph. The results are not finalized until you click **OK**.

When you click OK, several things occur:

- A hidden worksheet is created and named **InterExtrapn** (To show a hidden window, see *Hiding a Window* on page 24).
- The resulting data set is named **InterExtrapn_wkscol**, where **n** is the inter/extrapolated curve number in the project (starting from 1) and **wkscol** is the concatenated worksheet and column name of the original data set

- The **InterExtrap n _wkscol** data set is plotted in the active graph layer.

Note that the interpolation or extrapolation is dependent on the type of line connecting the data points in the original data plot.

To learn how to perform calculations on data sets (row by row or using interpolation) using LabTalk, see *Performing Calculations on Data Sets Using LabTalk* on page 472.

Averaging Multiple Curves

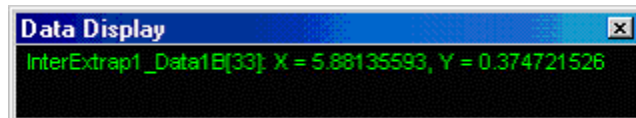
To calculate the average Y value for all data plots in the active layer at each X coordinate of the active data plot:

1. Select **Analysis:Average Multiple Curves**.
 - The result is saved as a new data set (in a new **Averagen** hidden worksheet) and plotted in the active layer (To show a hidden window, see *Hiding a Window* on page 24).
 - The new data set is named **Averagen_Mean N Cuv** where **n** is the average curve number in the project (starting from 1) and **N** is the number of data plots used to calculate the average.

If necessary, Origin will interpolate or extrapolate data plots when calculating the average Y value.

Data Exploration Tools

The Data Display Tool



The **Data Display** tool provides a dynamic display of the XY coordinates of a data point or a the location of the cursor on the screen. The Data Display tool opens when selecting these **Tools** toolbar tools:



The **Screen Reader** Tool



The **Data Reader** Tool



The **Data Selector** Tool




The **Draw Data** Tool

Additionally, the tool opens when moving or deleting data points, or when translating your data.

To enlarge or reduce the tool's display, drag a corner of the window. As a floating tool, position it anywhere in Origin's workspace.

To dock the Data Display tool, right-click on the tool and select (check) **Docking View** from the shortcut menu. The tool automatically docks to the toolbar region. If the **Docking View** shortcut menu command was already checked, double-click on the tool to dock it to the toolbar region. Alternatively, drag the tool to the edge of the workspace. The docked tool remains available throughout your Origin session, as well as for future Origin sessions.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

The Shortcut Menus Available from the Data Display Tool

Shortcut Menu Commands Made Available by Right-Clicking on the Tool's Title Bar

Move: Activates the tool so that it can be moved using the arrow keyboard keys.

Hide: Hides the tool for the current data exploration routine.

Shortcut Menu Commands Made Available by Right-Clicking inside the Tool

Note: To open the **Data Display Format** dialog box, right-click inside the Data Display Tool and select **Properties**.

Fixed Size: This shortcut menu command is only available when the **Automatically Fit to Display** check box in the **Data Display Format** dialog box is cleared.

Fixes the size of the text in the tool to the current size when this menu command is selected. Resizing the tool horizontally or vertically has no affect on the text size.

Fit Horizontally: This shortcut menu command is only available when the **Automatically Fit to Display** check box in the **Data Display Format** dialog box is cleared.

Displays the text in the tool so that it always displays in the full width of the tool. Resizing the tool horizontally causes the text size to change accordingly. Resizing the tool vertically has no affect on the text display.

Fit Vertically: This shortcut menu command is only available when the **Automatically Fit to Display** check box in the **Data Display Format** dialog box is cleared.

Displays the text in the tool so that it always displays in the full height of the tool. Resizing the tool vertically causes the text size to change accordingly. Resizing the tool horizontally has no affect on the text display.

Docking View: Automatically docks the tool to the toolbar region (if the shortcut menu command was not already selected). If the docked tool is then dragged to a floating tool, double-click on the tool to restore its docked position. Alternatively, drag the tool to the edge of the workspace.

Properties: Opens the **Data Display Format** dialog box.

Customizing the Display of the Data Display Tool

To customize the tool's coordinate display including the font, font color, and tool background color, right-click on the tool and select **Properties** from the shortcut menu. This shortcut menu command opens the **Data Display Format** dialog box.

The Data Display Format Dialog Box

The Font Drop-down List

Select the tool's text font display from this drop-down list.

The Font Color Drop-down List

Select the tool's text color display from this drop-down list.

The Background Color Drop-down List


Select the tool's background color display from this drop-down list.

The Automatically Fit to Display Check Box

Select this check box to ensure that all the text within the tool displays when the tool is resized. The text font size changes to accommodate changes in tool size.

When this check box is cleared, the **Fixed Size**, **Fit Horizontally**, and **Fit Vertically** shortcut menu commands are available. Select the desired command to control the text display in the tool.

The Data Selector Tool


To select a range of a data plot for analysis, click the **Data Selector** tool  on the Tools toolbar. Data markers display at both ends of the active data plot. Additionally, the **Data Display** tool opens if it is not already open.

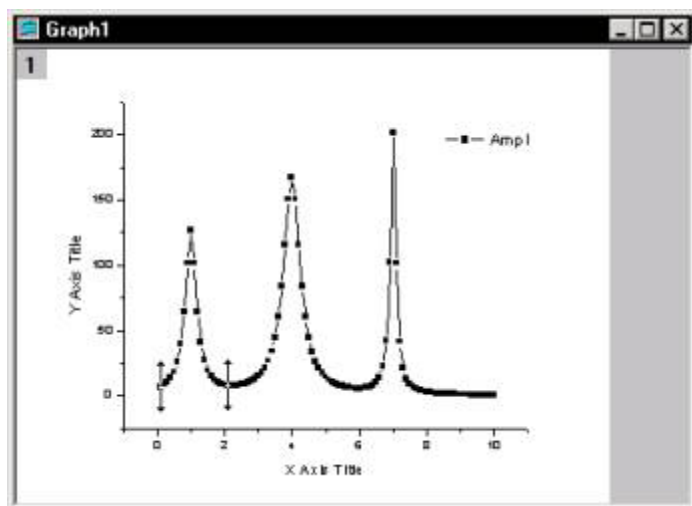
To mark the data segment of interest:

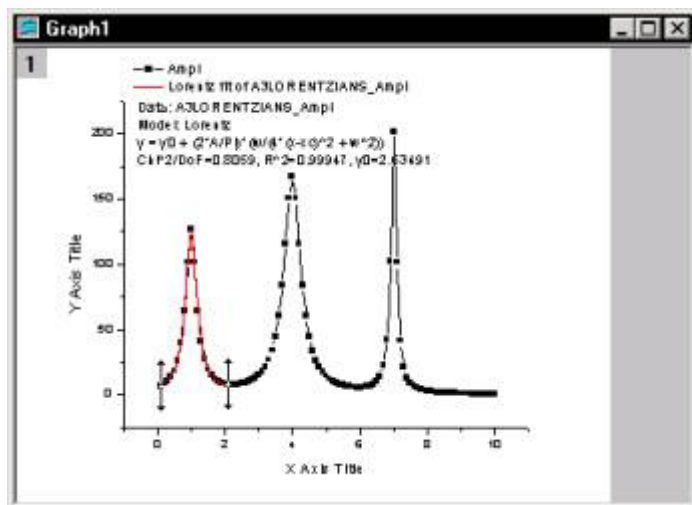
1. Click and drag the markers with the mouse. You can also use the left and right arrow keys to select a marker. The CTRL + left or right arrow keys move the selected marker to the next data point. Holding both the SHIFT and CTRL keys while depressing the left or right arrow keys moves the data markers in increments of five along the data plot.

Note: If your X data are not sorted, you may need to sort the data before selecting a range. To do this, activate the worksheet and select **Analysis:Sort Worksheet:Ascending.**)

As with the Data Reader tool, press the spacebar to increase the cross hair size.


After you have defined the range of interest, press ESC or click the **Pointer** button  on the Tools toolbar to set the data markers and define your segment of interest. Any analysis operations you perform on this data plot will apply to the selected region only ([see example](#)).






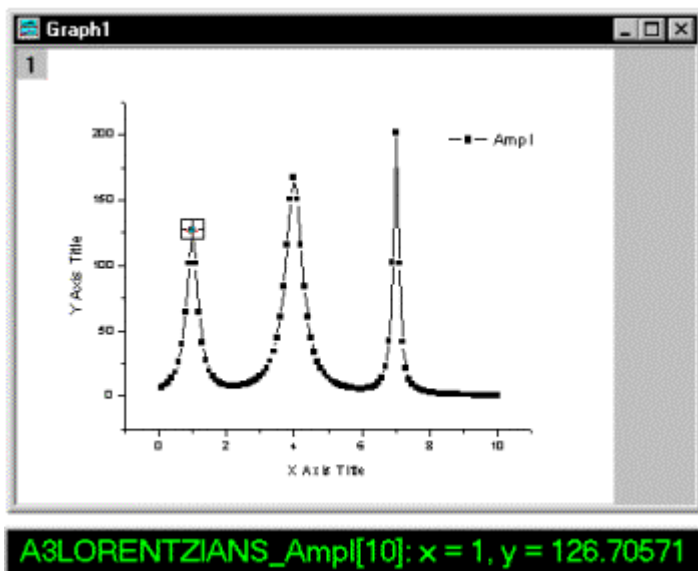
To hide data outside the selected range, select **Data:Set Display Range**.

To remove the selection range, select **Data:Reset to Full Range**.

 See your Origin software to view a multimedia demonstration on this topic ([Help:Multimedia Demonstrations](#)).

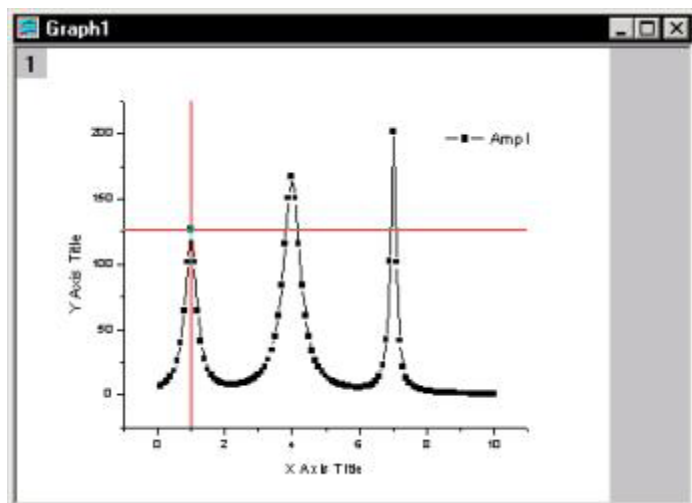
The Data Reader Tool


To read the X, Y, and Z (for 3D and contour) values for a data point, click the **Data Reader** button  on the Tools toolbar. This action opens the **Data Display** tool if it is not already open. Click on the desired data point to read its X,Y, and Z coordinates in the Data Display tool ([see figure](#)).




To move the cross-hair to the next data point along the data plot, use the left and right arrow keys or click on the data point.

To change the vertical and horizontal cross hair size after clicking on a point, press the spacebar. Continue pressing the spacebar to further increase the size of the cross hairs ([see example](#)).



Press ESC or click the Pointer button  on the Tools toolbar when you are finished with the Data Reader.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

A Note on Improving the Data Point Search Behavior of the Data Display Tool

When you click on a data plot using the Data Reader tool, Origin begins searching for the nearest point by one of two methods based on the number of points in the data plot and the Bisection Search Points combination box value on the Miscellaneous tab of the Options dialog box (**Tools:Options**).

- When the number of points is less than the bisection search value, then sequential search is used.
- When the number of points is greater than the bisection search value, then bisection search is used.


Bisection search is designed to find the nearest point rapidly, but it only works if the X data set is sorted. The middle point of the data set is tested first to determine which half contains the nearest point. This half becomes the new search set. If the X data set is not sorted, then this search scheme fails and you get a 'beep error'. (Actually a few points will be found this way purely by chance.)

If a search fails because bisection searching is being used on an unsorted (in X) data set, then you can either:


- Sort the source worksheet on the X column.
- Set the Bisection Search Points combination box to a value larger than the number of data points to 'turn off' bisection search.

Note: When you use the Data Reader tool to view the XY coordinates of a data point in a graph, Origin displays the actual X and Y data values for the data point, not the displayed worksheet values.

The Screen Reader Tool

To read the X, Y, and Z (for 3D and contour) values for any point on the screen, click the **Screen Reader** button  on the Tools toolbar. This action opens the **Data Display** tool if it is not already open. Click on the desired screen location to read its X,Y, and Z coordinates in the Data Display tool.

As with the **Data Reader** tool, you can press the spacebar to increase the cross hair size.

Press ESC or click the Pointer button  on the Tools toolbar when you are finished with the Screen Reader tool.


The Enlarger Tool and Undo Enlarge

When a data plot is magnified using the Enlarger tool, the axes are rescaled to show an expanded view of the data.

To magnify a portion of a data plot:

1. Click the **Enlarger** tool  on the Tools toolbar.

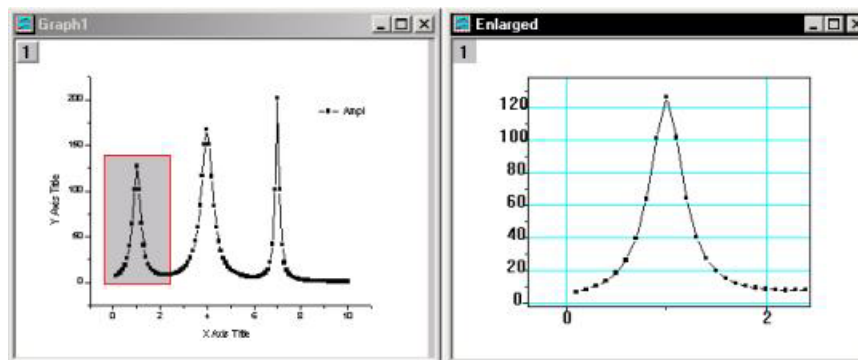
The expanded view can be displayed in either:

- The current window
 2. To view the magnified data in the current window, drag out an area of interest in the graph.
 3. To re-display the entire data plot, click the **Undo Enlarge** button .
- A new window

To view the magnified data in a new window:

2. Hold down the CTRL key while dragging out the area of interest in the graph window.
3. Release the mouse button, then release the CTRL key.

Origin opens a new graph window named **Enlarged**. A rectangle object with sizing handles appears in the original graph window (if the sizing handles are not displayed, click on the object to select it).



4. To change the data segment that displays in the Enlarged window, resize the rectangular object or drag the object in the original graph window. The Enlarged window updates accordingly.

After you finish analyzing the data, you can click on the rectangle object and delete it.

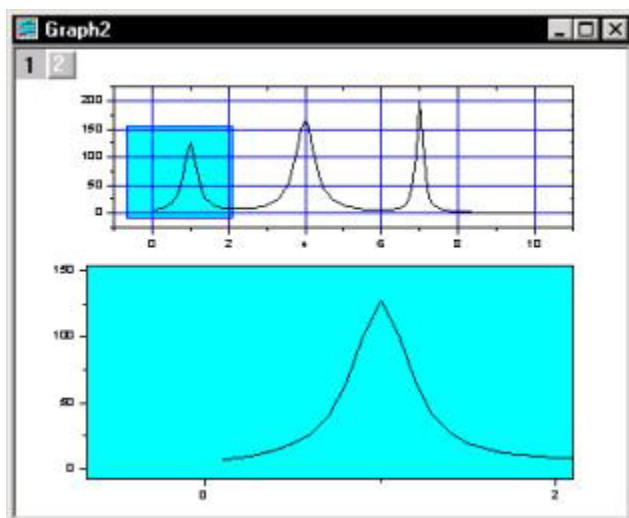
To view a magnified region of data in the *same* graph window (along with the full range of data):

1. Highlight the desired worksheet column(s) and click the **Zoom** button



on the 2D Graphs Extended toolbar.

A graph window with two layers opens. The top layer displays the entire data range and the bottom layer provides a zoomed-in view of your data plot.



To change the data segment in the bottom layer, resize the rectangular object or change its position by dragging the object in the top layer.

After you finish analyzing the data, you can click on the rectangle object and delete it.



[See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Region of Interest (Image Data)

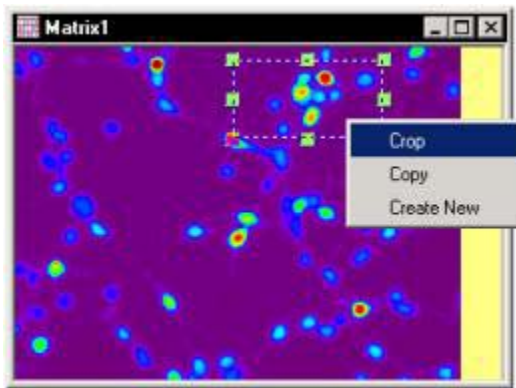
When you import image data in a matrix, you can select a region of the image using the **Rectangle Tool**



on the Tools toolbar. When a matrix with an image is active, the Rectangle tool displays in the "region of interest mode" by default. This setting is controlled from the **Tools:Region of Interest Tools** menu command.

To select a region of the image:

1. Select the **Rectangle Tool**, then drag out your region of interest.
2. Right-click inside the selected region and choose **Crop**, **Copy**, or **Create New** from the shortcut menu.

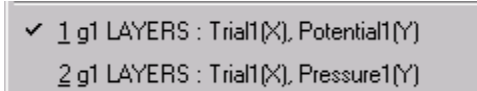


Analysis: Curve Fitting

Before You Begin


Before performing a linear or nonlinear fit, you must first activate the data plot which you intend to analyze. To make a data plot active:

1. Select the data plot from the data list at the bottom of the **Data** menu.



The data list includes all the data plots in the active layer. Note that the active data plot has a check-mark next to it.

Note that you are not restricted to performing your fit on an entire data set; you can specify a range of data from the data set. To select a range of a data plot for fitting:

1. Click the **Data Selector** tool  on the Tools toolbar.

Data markers display at both ends of the active data plot. Additionally, the Data Display tool opens if it is not already open.

To mark the data segment of interest:


2. Hold down the left mouse button and drag the data markers with the mouse.

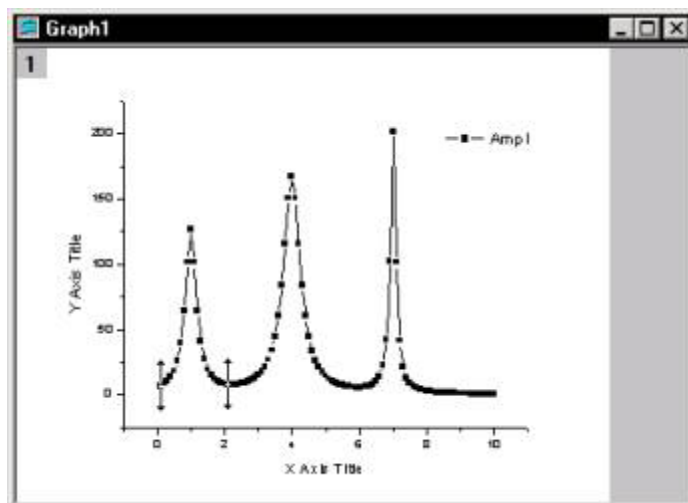
Note that you can also use the left and right arrow keys to select a marker.

- The CTRL + left or right arrow key moves the selected marker to the next data point.
- Holding both the SHIFT and CTRL keys while depressing the left or right arrow keys moves the data markers in increments of *five* along the data plot.

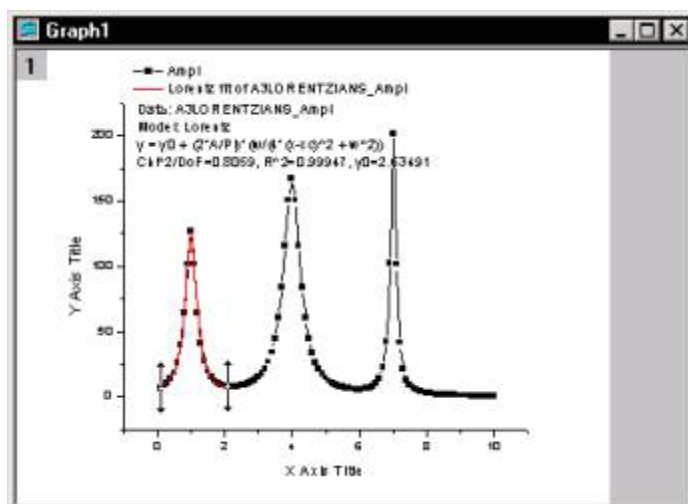
Note: If your X data is not sorted, you may need to sort the data before selecting a range. To do this, activate the worksheet and select **Analysis:Sort Worksheet:Ascending**.

As with the Data Reader tool, you can press the spacebar to increase the cross hair size.

3. When you have defined your range of interest, press ESC or click the **Pointer** button  on the Tools toolbar.



Any fitting operations you perform on this data plot will apply to the selected region only.



To hide the data outside this range, select **Data:Set Display Range**.


To remove the selection range, select **Data:Reset to Full Range**.

The Results Log

Origin automatically types results from most fitting operations to the Results Log. For more information, see The Results Log.

Linear Fitting From the Menu

Linear Regression

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

To fit a straight line to the active data plot:

1. Select **Analysis:Fit Linear**. With the X data, the independent variable, and the Y data, the dependent variable, the estimated linear regression model is stated as

$$Y_i = A + BX_i$$

where the parameters, A and B , are estimated by the method of least squares.

A is the
intercept:

$$A = \bar{Y} - B\bar{X}$$

B is the
slope:

$$B = \frac{\sum_i^N (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_i^N (X_i - \bar{X})^2}$$

After the fitting, Origin creates a new (hidden) worksheet containing the fitted data, and plots this data in the active graph window. Additionally, Origin copies the following parameters to the Results Log.

Parameter	Description
A	Intercept value and its standard error.
B	Slope value and its standard error.
R	Correlation coefficient.
p-value	Probability (that R is zero).
N	Number of data points.
SD	Standard deviation of the fit.

The standard deviation is defined
as

$$\sqrt{\frac{\sum_{i=1}^N (y_i - (A + Bx_i))^2}{N - 2}}$$

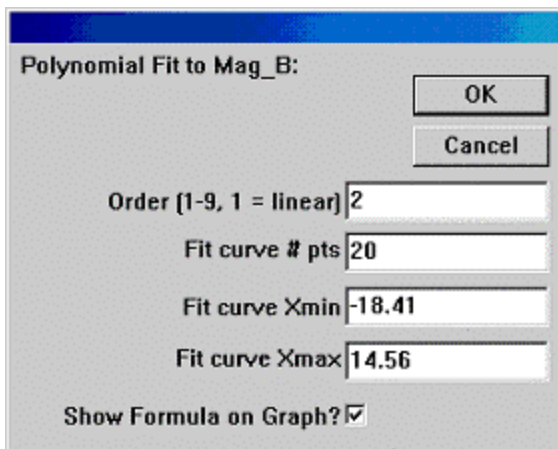
where (x_i, y_i) are the data points.

Polynomial Regression

To perform a polynomial fit on the active data plot:

1. Select **Analysis:Fit Polynomial**.

This menu command opens the **Polynomial Fit to Dataset** dialog box.



2. Specify polynomial **Order** (1 through 9), number of points drawn in the fit curve (**Fit curve # points**), and minimum (**Fit curve Xmin**) and maximum (**Fit curve Xmax**) X values for the fit curve.
3. To display the fit equation in the graph window, select the **Show Formula on Graph** check box.

With the X data, the independent variable, and the Y data, the dependent variable, a polynomial regression model of the k^{th} order is stated:

$$Y = A + B_1X + B_2X^2 + B_3X^3 + \dots + B_kX^k$$

After the fitting, Origin creates a new (hidden) worksheet containing the fitted data, and plots this data in the active graph window. Additionally, Origin copies the following parameters to the Results Log.

Parameter	Description
A, B_1, B_2 , etc.	The parameter estimates and standard errors.
R-square	R-square = (SYY-RSS)/SYY.
p-value	Probability (that R-square is zero).
N	Number of data points.
SD	Standard deviation of the fit.

Linear Fitting Using the Tools

The Linear Fit Tool

If a worksheet is the active window, you must select a Y column to perform linear regression. The Y column is used as the *dependent* variable and the associated X column is used as the *independent* variable. For weighted fitting, the error bar column must be selected along with the Y column. Note that the data columns must be either of **Format = Numeric** or **Text & Numeric**.

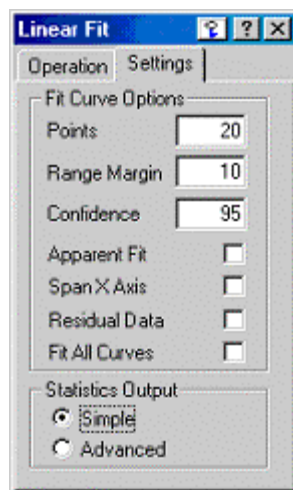
If the graph window is active, the regression is performed on the active data plot. To set the active data plot, select it from the data list at the bottom of the **Data** menu. For weighted fitting, the error bars must be plotted.

To open the Linear Fit tool:

1. Select **Tools:Linear Fit**.

Linear Fit Tool Controls

The Settings Tab



The Fit Curve Options Group

Points. Type the number of points to be used in the fit curve data set.

Range Margin. Type the percent outside of the data plot's X value range to create the fit curve (left and right).

Confidence. Type the confidence level for calculating confidence and prediction limits.

Apparent Fit. Select the Apparent Fit check box to use the apparent values for fitting, according to the current axis scales. Select this box to fit exponentially decaying data with a straight line fit when data are plotted on a log scale. When this check box is selected and the data has error values associated with it, Origin uses the larger of the positive/negative errors as weight.

Note: To learn more about the apparent fit option, review the APPARENT FIT.OPJ project located in your Origin \SAMPLES\ANALYSIS\CURVE FITTING folder.

Span X Axis. Select the Span X Axis check box to calculate a fit curve that spans the entire X axis. The graph is redrawn after fitting to display the entire fit curve over this range.

Residual Data. Select the Residual Data check box to create two columns in the associated data set worksheet. Column Fit(Y) contains the fitting values. Column Residual(Y) contains the residual values.

Fit All Curves. Select the Fit All Curves check box to fit all the data plots in the layer.

The Statistics Output Group

Simple. Select the Simple radio button to output simple fitting statistics to the Results Log, including intercept and slope values and standard errors, R (Correlation Coefficient), Standard Deviation, number of points in the raw data curve, and P (the P value for the t-test of the slope = 0).

Advanced. Select the Advanced radio button to output all fitting statistics to the Results Log, including the t-test values and the ANOVA table.

Notes on Confidence Intervals

The Linear Fit tool reports confidence intervals on the fit parameters when the **Advanced** radio button is selected. The confidence intervals can be checked to determine if their slope is significantly different from unity. If the confidence interval contains the number 1, then the conclusion would be that the slope is not significantly different from unity.

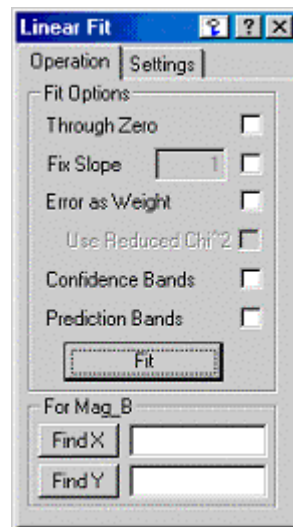
The formula for calculating the confidence intervals on the fit parameters is:

(fit parameter value) +/- (standard error on parameter value) * t-table(significance level, degrees of freedom)

The significance level is given by $(1 - (1 - \alpha)/2)$, where alpha is the confidence level. For example, if you set the confidence level in the Linear Fit tool to 95, then the significance level will be $(1 - (1 - 0.95)/2) = 0.975$. The t-table should then be calculated as t-table(0.975, DOF).

The Operation Tab

Select this tab to access the Operation options.



The Fit Options Group

Through Zero. Select the Through Zero check box to perform a linear regression through the origin when the Fit button is clicked on. When cleared, a standard linear regression is performed.

Fix Slope. Select the Fix Slope check box to restrict the slope to the value specified in the Fixed Slope text box on the Settings tab. When cleared, a standard linear regression is performed. Type the fixed slope for the fit curve in the associated text box.

Error as Weight. Select the Error as Weight check box to use error bars as weights ($1/\text{error}^2$). If the worksheet is active, a Y error bar column (select **Column: Set as Y Error**) must be selected in addition to the Y column when the Fit button is clicked. If the graph window is active, the error bars must be plotted.

Use Reduced Chi². When the Error as Weight check box is selected, the Use Reduced Chi² check box becomes available. The Use Reduced Chi² check box only affects the error on the parameters reported from the fitting process, and does not affect the fitting process or the data in any way.

When the Use Reduced Chi² check box is cleared, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii})$. This is the default, and recommended setting for this check box.

When the Use Reduced Chi² check box is selected, the error on the fit parameters are multiplied by the square root of the reduced chi-squared. In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii} * (\text{ChiSq}/\text{DOF}))$.

Confidence Bands. Select the Confidence Bands check box to plot upper and lower confidence band data sets with the fitting curve. The confidence band is calculated as

$$\hat{Y}_{x_0} \pm t(1 - \alpha / 2, n - 2) s \left\{ \hat{Y}_{x_0} \right\}$$

where

$$s^2 \left\{ \hat{Y}_{x_0} \right\} = \text{MSE} [1/n + (X_0 - \bar{X})^2 / \sum (X_i - \bar{X})^2]$$

\hat{Y}_{x_0} is the unbiased estimator of the expected value of Y at X_0 . The band will flare out the further it gets from the mean.

Prediction Bands. Select the Prediction Bands check box to plot upper and lower prediction band data plots with the fitting curve. The prediction band is calculated as

$$\hat{Y}_{x_0} \pm t(1 - \alpha / 2, n - 2) s \{ \text{pred} \}$$

where

$$s^2 \{ \text{pred} \} = \text{MSE} + s^2 \left\{ \hat{Y}_{x_0} \right\}$$

\hat{Y}_{x_0} is the unbiased estimator of the expected value of Y at X_0 . This band is wider than the confidence band due to $s \{ \text{pred} \}$.

Fit. Click Fit to perform a linear regression on the selected data plot according to the tool settings. If a worksheet is active, the highlighted Y column is used as the dependent variable. The associated X column is used as the independent variable. If a graph window is active, the regression is performed on the active data plot. After the fitting, Origin creates a new (hidden) worksheet containing the fitted data, and plots this data in the active graph window. If the data set has not yet been plotted, a new default graph window opens with the selected Y data set (and its associated X data set, row number, or incremental X value) and fitting data plotted in layer 1. Additionally, Origin displays the fitting results in the Results Log.

When the Simple radio button is selected, the following results are reported:

A: Intercept value and its standard error.

B: Slope value and its standard error.

R: Correlation coefficient.

p-value: Probability (that R is zero).

N: Number of data points.

SD: Standard deviation of the fit.

Additional results are provided when the Advanced radio button is selected. These include the t-values for testing if the parameter equals zero, where $t = \frac{\text{parameter estimate}}{\text{standard error of the estimate}}$, and their corresponding p-values. Additionally, the results include $R\text{-square} = (SSY - RSS) / SSY$, adjusted $R\text{-square} = 1 - [(1 - R\text{-square}) * (N - 1) / (N - 2)]$, and the ANOVA table.


The Calculate (**Find X/Find Y**) Group

Find X/Find Y. The Find X and Find Y buttons allow you to obtain a Y value given an X value, or obtain an X value given a Y value, respectively, from the fit you perform to the data. These buttons become active only after you perform a fit to the active data set.

Once the fit has been performed and the buttons are active, you can enter a numerical value in the top text box next to the Find X button, and then press the Find Y button to obtain the corresponding X value. The exact fit equation that resulted from the fitting process is used to compute the Y value for the given X value. You can specify any X value inside or outside of the range of the data set or the fit line for computing the Y value.

To find an X value for a given Y value, you should enter the Y value in the bottom text box next to the Find Y button and then press Find X. When this action is performed, the X value is determined in the following way:

The fit equation $Y = A + B * X$ is inverted to give $X = (Y - A) / B$ and this inverted equation is used to compute the exact X value for the given Y value. You can specify any Y value inside or outside of the range covered by the data set or the fit line to compute the corresponding X value.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

Note: To learn more about linear fitting with the Linear Fit tool, review the LINEAR FIT.OPJ project located in your Origin \SAMPLES\ANALYSIS\CURVE FITTING folder.

The Polynomial Fit Tool

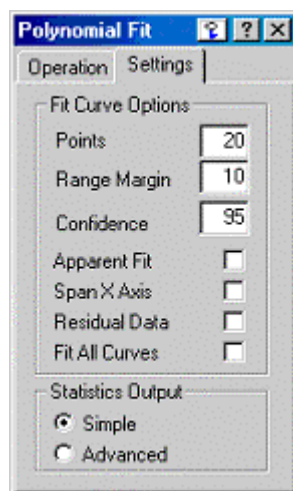
If a worksheet is the active window, you must select a Y column to carry out polynomial regression. The Y column is used as the dependent variable and the associated X column is used as the independent variable.

For weighted fitting, the Y error bar column must be selected along with the Y column for fitting. Note that the data columns must be either of **Format = Numeric** or **Text & Numeric**.

If the active window is a graph window, the regression is performed on the active data plot. To set the active data plot, select it from the data list at the bottom of the **Data** menu. For weighted fitting, the error bars must be plotted.

To open the Polynomial Fit tool:

1. From the menu, select **Tools:Polynomial Fit**.

The Settings TabThe Fit Curve Options Group

Points. Type the number of points to be used in the fit curve data set in the Points text box.

Range Margin. Type the percent outside of the data plot's X value range to create the fit curve (left and right) in the Range Margin text box.

Confidence. Type the confidence level for calculating confidence and prediction limits in the Confidence text box.

Apparent Fit. Select the Apparent Fit check box to use the apparent values for fitting, according to the current axis scales. Select this box to fit exponentially decaying data with a straight line fit when data are plotted on a log scale. When this check box is selected and the data has error values associated with it, Origin uses the larger of the positive/negative errors as weight.

Span X Axis. Select the Span X Axis check box to calculate a fit curve that spans the entire X axis. The graph is redrawn after fitting to display the entire fit curve over this range.

Residual Data. Select the Residual Data check box to create two columns in the associated data set worksheet. Column Fit(Y) contains the fitting values. Column Residual(Y) contains the residual values.

Fit All Curves. Select the Fit All Curves check box to fit all the data plots in the layer.

The Statistics Output Group

Simple. Select the Simple radio button to output simple fitting statistics to the Results Log, including the intercept and B_1, B_2 , etc. values and errors, R-Square (Coefficient of Determination), Standard Deviation, number of points in the raw data curve, and P (the P value for R-square = 0).

Advanced. Select the Advanced radio button to output all fitting statistics to the Results Log, including the t values and the ANOVA table.

Notes on Confidence Intervals

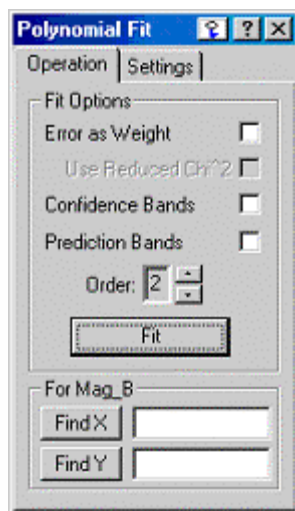
The Polynomial Fit tool reports confidence intervals on the fit parameters when the Advanced radio button is selected. The confidence intervals can be checked to determine if their slope is significantly different from unity. If the confidence interval contains the number 1, then the conclusion would be that the slope is not significantly different from unity.

The formula for calculating the confidence intervals on the fit parameters is:

(fit parameter value) \pm (standard error on parameter value) * t-table(significance level, degrees of freedom)

The significance level is given by $(1 - (1 - \alpha)/2)$, where alpha is the confidence level. For example, if you set the confidence level to 95, then the significance level will be $(1 - (1 - 0.95)/2) = 0.975$. The t-table should then be calculated as t-table(0.975, DOF).

The Operation Tab



The Fit Options Group

Error as Weight. Select the Error as Weight check box to use error bars as weights ($1/\text{error}^2$). If the worksheet is active, a Y error bar column (select **Column: Set as Y Error**) must be selected in addition to the Y column when the Fit button is clicked. If the graph window is active, the error bars must be plotted.

Use Reduced Chi². When the Error as Weight check box is selected, the Use Reduced Chi² check box becomes available. The Use Reduced Chi² check box only affects the error on the parameters reported from the fitting process, and does not affect the fitting process or the data in any way.

When the Use Reduced Chi² check box is cleared, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii})$. This is the default, and recommended setting for this check box.

When the Use Reduced Chi² check box is selected, the error on the fit parameters are multiplied by the square root of the reduced chi-squared. In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii} * (\text{ChiSq}/\text{DOF}))$.

Confidence Bands. For the polynomial fit, the confidence band is calculated as

$$\hat{Y}_{X_0} \pm t(1 - \alpha/2, n - k) s\{\hat{Y}_{X_0}\}$$

where

$$s^2\{\hat{Y}_{X_0}\} = MSE[1/n + (X_0 - \bar{X})^2 / \sum (X_i - \bar{X})^2]$$

\hat{Y}_{X_0} is the unbiased estimator of the expected value of Y at X_0 .

Prediction Bands. The prediction band is calculated as

$$\hat{Y}_{X_0} \pm t(1 - \alpha/2, n - k) s\{pred\}$$

where

$$s^2\{pred\} = MSE + s^2\{\hat{Y}_{X_0}\}$$

\hat{Y}_{X_0} is the unbiased estimator of the expected value of Y at X_0 .

Set the order for the regression, ranging from one to nine, using the Order spin buttons.

Fit. Click Fit to perform a polynomial regression on the selected data plot according to the tool settings. If a worksheet is active, the highlighted Y column is used as the dependent variable. The associated X column is used as the independent variable. If a graph window is active, the regression is performed on the active data plot. After the fitting, Origin creates a new (hidden) worksheet containing the fitted data, and plots this data in the active graph window. If the data set has not yet been plotted, a new default graph window opens with the selected Y data set (and its associated X data set, row number, or incremental X value) and fitting data plotted in layer 1. Additionally, Origin displays the fitting results in the Results Log.

When the Simple radio button is selected, the fitting results are:

A, B_1, B_2 , etc.: The parameter estimates and standard errors.

R-square: $R\text{-square} = (SSY - RSS)/SSY$.

p-value: Probability (that R-square is zero).

N: Number of data points.

SD: Standard deviation of the fit.

Additional results are provided when the Advanced radio button is selected. These include the t-values for testing if the parameter equals zero, where $t = \text{parameter estimate} / \text{standard error of the estimate}$, and their corresponding p-values. Additionally, the results include $R\text{-square} = (SSY - RSS)/SSY$, adjusted $R\text{-square} = 1 - [(1 - R\text{-square}) * (N - 1) / (N - k - 1)]$, and the ANOVA table.

The Calculate (Find X/Find Y) Group

Find X/ Find Y. The Find X and Find Y buttons allow you to obtain a Y value given an X value, or obtain an X value given a Y value, respectively, from the fit you perform to the data. These buttons become active only after you perform a fit to the active data set.

Once the fit has been performed and the buttons are active, you can enter a numerical value in the top text box next to the Find X button, and then press the Find Y button to obtain the corresponding X value. The exact fit equation that resulted from the fitting process is used to compute the Y value for the given X value. You can specify any X value inside or outside of the range of the data set or the fit line for computing the Y value.

To find an X value for a given Y value, you should enter the Y value in the bottom text box next to the Find Y button and then press Find X. When this action is performed, an iterative procedure is used to find the X value corresponding to the given Y value:

1. First a check is performed to see if the Y value you specified is inside the range of Y values described by the fit line. If not, no computation is done and you are informed that your Y value is out of range.

If the Y value passes this check, then the following steps are performed:

2. The fit line data set is scanned to find two points (X1,Y1) and (X2, Y2) such that the user-specified Y value lies in the interval [Y1, Y2]. In the case of a fit line that is not monotonic (.ie. multiple X value exist for same Y value), the first interval that satisfies this criterion, starting from the lower end of the X axis, is selected.
3. The X value of the mid point of this interval is computed: $X_m = (X1 + X2) / 2$, and the corresponding y-value, Y_m , is computed using the exact fit equation
4. The interval to the right or left of this midpoint is chosen such that the user-specified Y value now falls within the new interval.
5. This bisectional search is continued till the y-value of the mid point of the interval, Y_m , differs from the user-specified Y-value by less than 0.00001%, or until 200 iterations are performed, whichever comes first.
6. The X_m value corresponding to the final Y_m value is reported as the X value corresponding to the y-value you specified.

The Fit Comparison Tool

A Fit Comparison tool is available by selecting **Tools:Fit Comparison**. This tool compares two data sets by fitting the same function to the data. It then uses an F-test to determine whether the two data sets are significantly different from each other. Thus, the tool determines if the two data sets are representative samples from the same population or not. The results are output to the Results Log.

The Fit Comparison tool uses the following procedure to perform the comparison:

1. Origin fits the two data sets individually using the selected function. Origin then combines the two data sets (appending one to the other), and then performs a fit on the combined data set with the same function. From these three fits, Origin obtains values for the SSR (sum of squares of the difference between the data and fit values) and the DOF (number of degrees of freedom). Thus, the following values are obtained: SSR1, DOF1, SSR2, DOF2 from the individual fits, and SSRcombined and DOFcombined from the fit to the combined data.
2. Origin then computes the following:

$$SSR_{\text{separate}} = SSR1 + SSR2$$

$$DOF_{\text{separate}} = DOF1 + DOF2$$
3. Origin then computes an F value using the formula:

$$F = \frac{(SSR_{\text{combined}} - SSR_{\text{separate}}) / (DOF_{\text{combined}} - DOF_{\text{separate}})}{SSR_{\text{separate}} / DOF_{\text{separate}}}$$

4. Once the F value is computed, Origin calculates a p-value using the formula:

$$p = 1 - \text{invf}(F, (DOF_{combined} - DOF_{separate}), DOF_{separate})$$

This p-value is then used to make a statistical statement as to whether the data (not the parameter values) are significantly different or not. If the p-value is greater than 0.05, we can say that the data sets are not significantly different at the 95% confidence level.

A Note on Linear Fitting Theory

Theory of Linear Regression

Fitting to a Straight Line with Intercept: $Y=a+bX$

1. The estimated parameters are:

$$b = \frac{SXY}{SXX}$$

$$a = \bar{y} - b\bar{x}$$

Standard errors are:

$$se(b) = \frac{sd}{\sqrt{SXX}}$$

$$se(a) = sd \sqrt{\left(\frac{1}{w_{Total}} + \frac{\bar{x}^2}{SXX} \right)}$$

The estimated standard deviation of the fitting, with $df = n - 2$ is:

$$sd = \sqrt{\frac{RSS}{df}}$$

The residual sum of squares is:

$$RSS = \sum_{i=1}^n w_i [y_i - (a + bx_i)]^2$$

2. The $(1 - \alpha) \times 100\%$ confidence interval (confidence band) for the mean of Y is given by:

$$Y = bx \pm t(\alpha/2, n-2) \text{ sd} \sqrt{\frac{1}{w_{Total}} + \frac{(x - \bar{x})^2}{SXX}}$$

3. The coefficient of determination is:

$$COD = 1 - \frac{RSS}{SYY}$$

COD is also called R-squared since $COD = r^2$. The adjusted R-squared is:

$$R_{adj}^2 = 1 - [1 - r^2] \frac{n-1}{df}$$

4. The ANOVA for the fitting is summarized in the following table:

	Degrees of Freedom	Sum of Squares (SS)	Mean Squares (MS)	F
Regression	1	SSreg=SYY-RSS	MSreg=SSreg/1	MSreg/MSE
Residual	n-2	RSS	MSE=RSS/(n-2)	
Total	n-1	SYY		

The variable $F = MS_{reg}/MSE$ follows an F distribution $F(1, n-2)$. The P-value can be obtained from the F distribution.

Fitting to a Straight Line Through the Origin: $Y = bX$

- 1) The estimated parameter is

$$b = \frac{SXY}{SXX}$$

with standard error

$$se(b) = \frac{sd}{\sqrt{SXX}}$$

$$sd = \sqrt{\frac{RSS}{df}}$$

is the estimated standard deviation of the fitting, $df = n - 1$, and the residual sum of squares is

$$RSS = \sum_{i=1}^n w_i [y_i - bx_i]^2$$

2) The $(1 - \alpha) \times 100\%$ confidence interval (confidence band) for the mean of Y is given by:

$$Y = a + bx \pm t(\alpha/2, n-1) sd \sqrt{\frac{x^2}{sxx}}$$

3) The ANOVA for the fitting is summarized in the following table:

	Degrees of Freedom	Sum of Squares (SS)	Mean Squares (MS)	F
Regression	1	SSreg=SYX-RSS	MSreg=SSreg/1	MSreg/MSE
Residual	n-1	RSS	MSE=RSS/(n-1)	
Total	n	SYX		

The variable $F = MS_{reg}/MSE$ will follow an F distribution $F(1, n-1)$. The P-value can be obtained from the F distribution.

Theory of Polynomial Regression

To fit a polynomial of order k ($Y = b_0 + b_1X + b_2X^2 + \dots + b_kX^k$) to the data, assume the residuals $res_i = y_i - (b_0 + b_1x_i + b_2x_i^2 + \dots + b_kx_i^k)$ have normal (Gaussian) distributions with the mean = 0 and the variance = σ_i^2 .

Then the maximum likelihood estimates for the parameters $b[i]$ can be obtained by minimizing the chi-square

$$\chi^2 = \sum_{i=1}^N \frac{res_i^2}{\sigma_i^2} = \sum_{i=1}^N w_i res_i^2$$

Origin uses equal weight fitting by setting $\sigma_i = 1$.

1) The estimated parameters can be expressed in matrix form: $b = (\tilde{A}\tilde{A})^{-1}\tilde{A}Y$, where

$$b = \begin{bmatrix} b_0 \\ b_1 \\ \vdots \\ b_k \end{bmatrix} \quad A = \begin{bmatrix} \frac{1}{\sigma_1} & \frac{x_1^k}{\sigma_1} \\ \vdots & \vdots \\ \frac{1}{\sigma_n} & \frac{x_n^k}{\sigma_n} \end{bmatrix} \quad Y = \begin{bmatrix} \frac{y_1}{\sigma_1} \\ \vdots \\ \frac{y_n}{\sigma_n} \end{bmatrix}$$

The residual sum of squares is

$$RSS = \sum_{i=1}^N w_i res_i^2$$

The estimated standard deviation of the fitting is

$$sd = \sqrt{\frac{RSS}{df}}$$

and $df = n - (k + 1)$.

2) The ANOVA for the fitting is summarized in the following table:

	Degree of Freedom	Sum of Squares (SS)	Mean Squares (MS)	F
Regression	k	SSreg=SY-Y-RSS	MSreg=SSreg/k	MSreg/MSE
Residual	n-(k+1)	RSS	MSE=RSS/(n-k-1)	
Total	n-1	SY-Y		

The variable $F = MS_{reg}/MSE$ will follow an F distribution $F(k, df)$. The P-value can be obtained from the F distribution.

Theory of Multiple Regression

For given columns of data $(Y[i] \ X_1[i] \ X_2[i] \ \dots \ X_k[i])$, $i = 1, 2, \dots, N$, we assign the Y column to be the dependent variable, and all other X columns to be the independent variables. We fit the model:

$$Y = b_0 + b_1 X_1 + \dots + b_k X_k, \text{ assuming the residuals}$$

$$res_i = y_i - (b_0 + b_1 x_{1i} + b_2 x_{2i} + \dots + b_k x_{ki})$$

have normal (Gaussian) distributions with the mean = 0 and the variance = σ^2 . Then the maximum likelihood estimation for the parameters $b[i]$ can be obtained by minimizing the chi-square

$$\chi^2 = \sum_{i=1}^N res_i^2$$

- 1) The estimated parameters can be expressed in matrix form: $b = (\tilde{A}A)^{-1}\tilde{A}Y$

$$b = \begin{bmatrix} b_0 \\ b_1 \\ \vdots \\ b_k \end{bmatrix} \quad A = \begin{bmatrix} 1 & x_{11} & \dots & x_{k1} \\ \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n1} & \dots & x_{kn} \end{bmatrix} \quad Y = \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix}$$

The residual sum of squares is

$$RSS = \sum_{i=1}^N res_i^2$$

- 2) the estimated standard deviation of the fitting is

$$sd = \sqrt{\frac{RSS}{df}}$$

and $df = n - (k + 1)$.

- 3) The ANOVA for the fitting is summarized in the following table:

	Degree of Freedom	Sum of Squares (SS)	Mean Squares (MS)	F
Regression	k	SSreg=SY-Y-RSS	MSreg=SSreg/k	MSreg/MSE
Residual	n-(k+1)	RSS	MSE=RSS/(n-k-1)	
Total	n-1	SY-Y		

The variable $F = MS_{reg}/MSE$ will follow an F distribution $F(k, df)$. The P-value can be obtained from the F distribution.

Nonlinear Curve Fitting from the Menu

First Order Exponential Decay

Select **Analysis:Fit Exponential Decay:First Order** to fit a curve to the active data plot, using the equation:

$$y = y_0 + A_1 e^{-x/A_2}$$

where

y_0 = Y offset

A_1 = amplitude

t_1 = decay constant

When you select this menu command, Origin makes the necessary initialization for the parameters. Origin also sets y_0 to an appropriate fixed number which is close to the asymptotic value of the Y variable for large X values.

Note: When fitting from the menu, all the parameters by default vary during the iterative procedure. If you want to fix certain parameters to particular values, you must open the curve fitter's dialog box.

Second Order Exponential Decay

Select **Analysis:Fit Exponential Decay:Second Order** to fit a curve to the active data plot, using the equation:

$$y = y_0 + A_1 e^{-x/t_1} + A_2 e^{-x/t_2}$$

This menu command opens the Verify Initial Guesses dialog box in which you specify initial values for the fitting parameters.

Fitting to multiple exponentials is more difficult than fitting to a single exponential. You must make good guesses for the fitting parameters. You may need to enter the nonlinear fitting session to get better control for the fitting.

Note: To learn more about second order exponential decay fitting, review the EXP DECAY.OPJ project located in your Origin \SAMPLES\ANALYSIS\CURVE FITTING folder.

Third Order Exponential Decay

Select **Analysis:Fit Exponential Decay:Third Order** to fit a curve to the active data plot, using the equation:

$$y = y_0 + A_1 e^{-x/t_1} + A_2 e^{-x/t_2} + A_3 e^{-x/t_3}$$

This menu command opens the Verify Initial Guesses dialog box in which you specify initial values for the fitting parameters.

Exponential Growth

Select **Analysis:Fit Exponential Growth** to fit a curve to the active data plot, using the equation:

$$y = y_0 + A_1 e^{x/t_1}$$

where

y_0 = Y offset

A_1 = amplitude

t_1 = "time" constant

Gaussian

Select **Analysis:Fit Gaussian** to fit a curve to the active data plot, using the equation:

$$y = y_0 + \frac{A}{w \cdot \sqrt{\frac{\pi}{2}}} e^{-\frac{2(x-x_0)^2}{w^2}}$$

where

y_0 = baseline offset

A = total area under the curve from the baseline

x_0 = center of the peak

w = 2 “sigma”, approximately 0.849 the width of the peak at half height

This model describes a bell-shaped curve like the normal (Gaussian) probability distribution function. The center x_0 represents the “mean”, while $w/2$ is the standard deviation.

Lorentzian

Select **Analysis:Fit Lorentzian** to fit a curve to the active data plot, using the equation:

$$y = y_0 + \frac{2 \cdot A}{\pi} \cdot \frac{w}{4(x - x_0)^2 + w^2}$$

where

y_0 = baseline offset

A = total area under the curve from the baseline

x_0 = center of the peak

w = full width of the peak at half height

The parameters in the Lorentzian model are similar to the parameters defined for the Gaussian model.

Sigmoidal

Boltzmann Equation

When the X axis is set to linear scale, the **Analysis:Fit Sigmoidal** menu command uses the Boltzmann equation for fitting:

$$y = \frac{A_1 - A_2}{1 + e^{(x-x_0)/dx}} + A_2$$

where

x_0 = center

dx = width

A_1 = initial Y value: $y(-\infty)$

$$A_2 = \text{final Y value: } y(+\infty)$$

The Y value at x_0 is half way between the two limiting values A_1 and A_2 : $y(x_0) = (A_1 + A_2)/2$. The Y value changes drastically within a range of the X variable. The width of this range is approximately dx .

Logistical Equation

When the X axis is set to a logarithmic scale, the **Analysis:Fit Sigmoidal** menu command uses the Logistical equation for fitting:

$$\frac{A_1 - A_2}{1 + (x / x_0)^p} + A_2$$

where

x_0 = center

p = power

A_1 = initial Y value

A_2 = final Y value

The Y value at x_0 is half way between the two limiting values A_1 and A_2 : $y(x_0) = (A_1 + A_2)/2$.

Using the Sigmoidal Fit Tool

The Sigmoidal Fit tool provides an intermediate level of sophistication for Sigmoidal fitting that is more advanced than the **Analysis:Fit Sigmoidal** menu command and simpler than the **Analysis:Non-Linear Curve Fit:Advanced Fitting Tool** menu command. The fitting function used depends on

- The X axis scale type.
- The selected radio button in the **Logged Data Fit Function** group on the **Settings** tab.

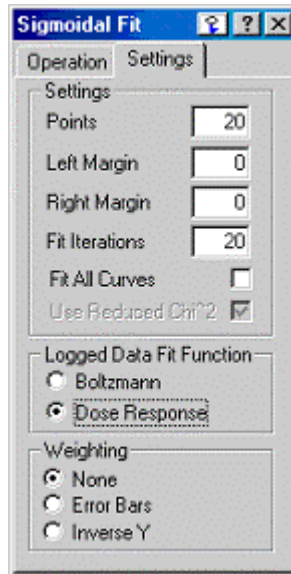
To open the Sigmoidal Fit tool:

1. From the menu, select **Tools:Sigmoidal Fit**.

Note: To learn more about fitting with the Sigmoidal Fit tool, review the SIGMOIDAL FIT.OPJ project located in your Origin \SAMPLES\ANALYSIS\CURVE FITTING folder.

The Settings Tab

Select this tab to access the **Settings** options.



The Fit Curve Options Group

Points. Specify the number of points to create for the fit curve.

Left Margin/Right Margin. The proportion outside of the X value range, as a percentage, to draw the fit curve (left and right).

Fit Iterations. The number of iterations of the fitting to perform in the associated text boxes.

Fit All Curves. Select the Fit All Curves check box to fit all the data plots in a layer.

The **Use Reduced Chi²** check box only affects the error on the parameters reported from the fitting process, and does not affect the fitting process or the data in any way.

Select the Reduced Chi² check box when there are no associated error bars with the data (which is the default - and only - option). In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii} * (\text{ChiSqr}/\text{DOF}))$.

Clear the Reduced Chi² check box when the data has associated error bars and a weighting method is other than None. This is the default, and recommended setting for this check box. The error on the fit parameter is then calculated as $\text{SQRT}(\text{cov}_{ii})$.

When the data has associated error bars and you have chosen a weighting method (other than None), you have the option to select the check box, thereby multiplying the reported error on the fit parameters by the square root of the reduced chi-squared. In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii}(\text{ChiSqr}/\text{DOF}))$.

The Logged Data Fit Function Group

Select either the **Boltzmann** or **Dose Response** (logistic) function to fit logged data (for example, 10^7 plotted as 7).

Note: If the X axis scale is set to Log10, the Dose Response (logistic) function is always used, independent of your radio button selection.

The Weighting Group

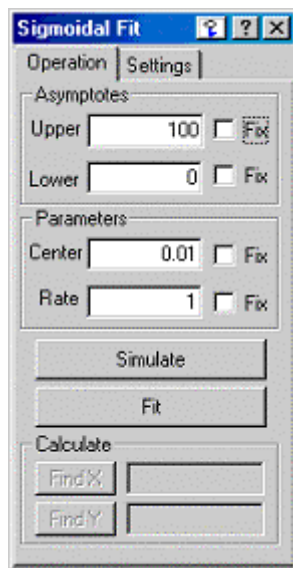
None. No weighting.

Error Bars. If you select the Error Bars radio button, you must have selected a Y error bar column with your Y column in a worksheet, or plotted your data with error bars in a graph. In this case, Origin uses $1/\text{errbar}^2$ as the weighting.

Inverse Y. For inverse Y weighting, Origin uses $1/Y$ where Y is the data that is being fitted to.

The Operation Tab

Select this tab to access the Operation options.



The Asymptotes Group and Associated Fix Check Boxes

Upper/Lower. Specify the parameters $A1$ and $A2$ in the Upper and Lower text boxes to be used as the initial values for fitting.

Fix. Select the associated Fix check boxes to lock in the entered value as a constant rather than allowing it to vary during fitting.

The Parameters Group and Associated Fix Check Boxes

Center/Rate. Specify the initial value for the parameter $x0$ in the Center text box. Specify the initial value for the parameter dx or p in the Rate text box.

Fix. Select the associated Fix check boxes to lock in the entered value as a constant.

The Fit Button

Click **Fit** to execute the fitting routine and update the variables that have not been set to fixed.

The Simulate Button

If you have specified the values for the parameters and a graph window is active, click **Simulate** to create a function that can be used like any other function. This can also help you to better determine the initial parameter values for the fit. You can double-click on the function curve or select the function in the data list at the bottom of the **Data** menu (select the function from the data list twice, as the first action simply makes the function the active data set). Both actions open the Function tab of the Plot Details dialog box.

The Calculate (Find X/Find Y) Group

The **Find X** and **Find Y** buttons allow you to obtain a Y value given an X value, or obtain an X value given a Y value, respectively, from the fit you perform to the data. These buttons become active only after you perform a fit to the active data set.

Once the fit has been performed and the buttons are active, you can enter a numerical value in the top text box next to the Find X button, and then press the Find Y button to obtain the corresponding X value. The exact fit equation that resulted from the fitting process is used to compute the Y value for the given X value. You can specify any X value inside or outside of the range of the data set or the fit line for computing the Y value.

To find an X value for a given Y value, you should enter the Y value in the bottom text box next to the Find Y button and then press Find X. When this action is performed, an iterative procedure is used to find the X value corresponding to the given Y value:

1. First a check is performed to see if the Y value you specified is inside the range of Y values described by the fit line. If not, no computation is done and you are informed that your Y value is out of range.

If the Y value passes this check, then the following steps are performed:

2. The fit line data set is scanned to find two points (X1,Y1) and (X2, Y2) such that the user-specified Y value lies in the interval [Y1, Y2]. In the case of a fit line that is not monotonic (.ie. multiple X value exist for same Y value), the first interval that satisfies this criterion, starting from the lower end of the X axis, is selected.
3. The X value of the mid point of this interval is computed: $X_m = (X_1 + X_2) / 2$, and the corresponding y-value, Ym, is computed using the exact fit equation
4. The interval to the right or left of this midpoint is chosen such that the user-specified Y value now falls within the new interval.
5. This bisectional search is continued till the y-value of the mid point of the interval, Ym, differs from the user-specified Y-value by less than 0.00001%, or until 200 iterations are performed, whichever comes first.
6. The Xm value corresponding to the final Ym value is reported as the X value corresponding to the y-value you specified.

Fitting a Data Plot with Multiple Peaks

Multiple Gaussian

To fit a curve with multiple Gaussian peaks to the active data plot:

1. From the menu, select **Analysis:Fit Multi-peaks:Gaussian**.

This menu command opens the **Number of Peaks** dialog box>

2. Enter the number of peaks.
3. Click **OK** to close the dialog box.

This opens the **Initial Half Width Estimate** dialog box. Origin estimates the overall half-width through integration, and then divides by the number of peaks, to arrive at the half-width estimate.

4. Modify or accept the estimated value in the Initial Half Width Estimate dialog box.
5. Click **OK** to close the dialog box.

The Data Display tool opens if not already open.

6. To read the XY coordinates of a data point in the Data Display tool, click on the desired point.
7. To determine a peak position, double-click (or click + ENTER) on a data point.

When complete, the fitting parameters, as well as related statistics, are displayed in the graph window and the Results Log. Additionally, the fit data is copied to a new (hidden) worksheet.

Multiple Lorentzian

To fit a curve with multiple Lorentzian peaks to the active data plot:

1. From the menu, select **Analysis:Fit Multi-peaks:Lorentzian**. This menu command is similar to the **Multiple Gaussian** menu command as it allows you to specify the number of peaks, and then invokes fitting to multiple Lorentzian functions.

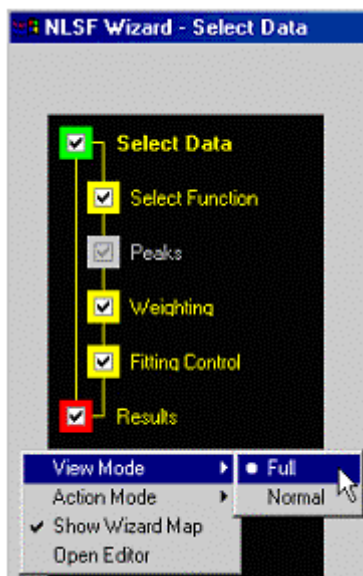
The NLSF Wizard

Creating a Custom Wizard

After you become familiar with the NLSF wizard, you might find that you consistently perform the same actions on some wizard pages and no actions on other wizard pages. If you step through the wizard pages in a similar way when fitting data, you can simplify the wizard by hiding pages that you either perform *no* actions on or ones that you always perform the *same* actions on. You can then save this customized wizard to a new toolbar button for future access.

To hide a page in the wizard:

1. Right-click on a blank section of the wizard (for example, beneath the wizard map) and select **View Mode:Full**. The Full view mode is the wizard design mode. This view mode allows you to turn off the display of wizard pages by clearing the associated check box located on the wizard map.



Now you can step through the wizard specifying which pages you want to hide.

- To hide a page that you never perform any actions on, clear the associated check box on the wizard map.



- To hide a page that you want to perform the same actions on, manually perform the action on the page (for example, click the Iterate button on the Fitting Control page) and then clear the page's check box

on the wizard map. When this page is skipped when you run your customized wizard, the wizard will automatically perform the action.

The following actions can be saved to a custom wizard:

Select Data page: No actions are saved on this page. However, you can hide and skip this page because the active data set is used by default.

Select Function page: You can save a procedure to a button and have it remember the fitting function chosen during that fitting session. This allows you to create multiple customized fitting routines that use different functions.

Peaks page: No actions are saved on this page. You can only hide and skip this page if your data set has a single peak.

Weighting page: This page can only be hidden and skipped if your weighting method is set to None, Instrumental, or Statistical - because Arbitrary and Direct require a data set selection.

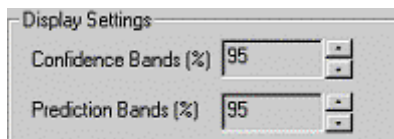
Fitting Control page: This page can be hidden and skipped. However, only the **Iteration** button is recorded. The χ^2 button is non-recordable.

The following settings are saved to the NLSF.INI file:



- **Tolerance.**
- Default for the **Iterations** drop-down list and button.

The following settings are saved to the NLSFwizard.INI file:

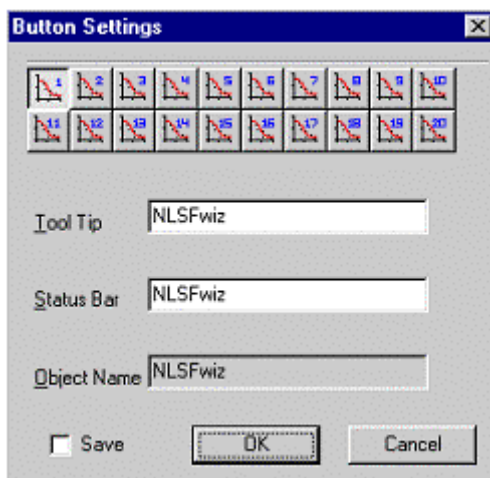


- **Confidence** Spin/Edit.
- **Prediction** Spin/Edit.

Results page: You cannot hide and skip this page.

After clearing the desired wizard map check boxes, perform the following steps to create your custom wizard:

1. On the Results page, select the **Save Fitting Session as a Procedure File** check box.
2. Right-click again on a blank section of the wizard and select **View Mode:Normal** from the shortcut menu. The wizard map updates displaying only the non-hidden pages.
3. Click the **Finish** button. This action opens the Button Settings dialog box.



This dialog box allows you to save your current wizard settings and actions to a new toolbar button.

When the Button Settings dialog box opens after you click the wizard's Finish button, the top left button in the dialog box will be depressed. You can assign your custom wizard settings to this button or you can select another button*.

You can specify Tool Tip and Status Bar messages for your button.

After you click the **OK** button, Origin adds this button to a new NLSFWiz toolbar.

***Note:** This dialog box does not recognize if a bitmap button is already in use.

Note: A number of settings are saved globally and are independent of custom wizards. These include the tolerance and iterations settings which are saved to the NLSF.INI file. Additionally, the confidence and prediction settings, as well as many other wizard settings, are saved as global settings in the NLSFWizard.INI file. Open either initialization file in a text editor to view the settings.

The Nonlinear Least Squares Fitter

Entering the Nonlinear Least Squares Curve Fitting Session

Two NLSF Modes: Basic and Advanced

To help you master the power of Origin's nonlinear least squares fitter, two NLSF modes are available: **Basic** and **Advanced**. While both modes allow you to fit your data, they differ substantially in the options they provide as well as in the degree of complexity they entail.

The Basic mode is much simpler to use and understand. Use this mode to:

- Select a function from a reduced set of built-in functions.
- Select data sets for fitting.
- Perform an iterative fitting procedure.
- Display the results on the graph.

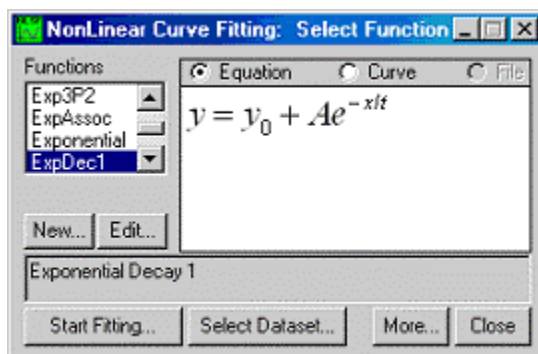
The Advanced mode includes more options. Use this mode to:

- Define a LabTalk script or Origin C code to initialize parameters.

- Impose linear constraints.
- Define your own fitting functions.
- Specify a weighting method and termination criteria.
- Display confidence and prediction bands, residue plot, parameter worksheet, and the variance-covariance matrix.
- Fit multiple data sets with a choice of shared parameters.
- Change parameter names.

Using the Fitter in the Basic Mode: Examples

By default, when you select **Analysis:Non-linear Curve Fit:Advanced Fitting Tool** from the menu when a graph or a worksheet window is active, Origin's nonlinear least squares fitter starts in the basic mode. When the fitter is in the basic mode, it does *not* have its own menu bar.



Switch from the basic to the advanced mode at any time by clicking on the **More** button.

Fitting a First Order Exponential Decay Function using the Fitter's Basic Mode

Opening a Project File

1. Click the **Open** button on the Standard toolbar to open the Open dialog box. Select **Project (*.OPJ)** from the Files of Type drop-down list.
2. In the Origin TUTORIAL folder, double-click on FITEXMP1.OPJ in the list of files. This action opens the Fitexmp1 project with a Graph1 window displaying sample data.

Starting the Basic Mode of the NLSF

1. With the graph window active, select **Analysis:Non-linear Curve Fit:Advanced Fitting Tool**. This menu command opens the Select Function dialog box of the NLSF. If the advanced mode is displayed instead, select **Options:Basic Mode** from the fitter's menu to display the basic mode.

Selecting a Function

1. If the Select Function dialog box is not displayed, click **Select Function** to display it.
2. In the Functions list box, click on **ExpDec1** to select the First Order Exponential Decay function.

Starting the Fitting

1. Click **Start Fitting**. An Attention message opens informing you that you have not selected a data set for fitting. You can choose to fit either the current active data set (**data1_b**) or select

another data set. Select the active data set. The Fitting Session dialog box replaces the Select Function dialog box.

Fixing Parameters

Suppose that you want to fit the data to the exponential decay function but with a *fixed* value of the vertical offset y_0 (=4).

1. Type **4** in the Value text box for the y_0 parameter. Clear the Vary check box for this parameter.
2. Type **8** in the Value text box for the A1 parameter. This is the initial value for this parameter. Leave the initial value for the t1 parameter at 1.
3. Make sure that the Vary check boxes for the A1 and t1 parameters are selected. They may thus vary during the iterative procedure.

Performing Iterations

1. Click **1 Iter** to perform one iteration. New values of the parameters A1 and t1 are displayed together with the current value of the reduced χ^2 . Notice that the parameter y_0 , which we fixed in the previous step, remained unchanged. The theoretical curve corresponding to the current parameter values is displayed in Graph1.
2. Click **10 Iter** to perform (at most) 10 iterations. Notice the improvement of the fit.

Finishing Fitting

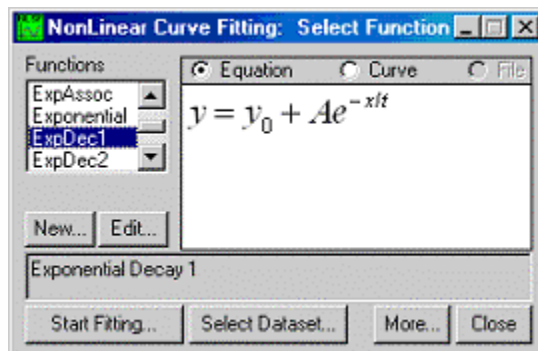
1. Click **Done**. The fitter's dialog box closes. The parameter values are displayed on the graph.

The Dialog Boxes of the Basic Mode

Basic Mode: The Select Function Dialog Box

By default, this dialog box is displayed when you invoke the curve fitter. You can also access it from the Select Data Set and Fitting Session dialog boxes by clicking on the **Select Function** button.

Select Function Dialog Box Controls



The Functions List Box

This list box provides the list of fitting functions available in the basic mode. In addition to a set of built-in functions, all user-defined functions are displayed. Select a function by clicking on its name.

The View Box

If you have selected a built-in function, the view box to the right of the Functions list box displays either the function's definition (equation) or a curve which shows the function's profile. Switch between the two by selecting the corresponding radio buttons at the top of the view box. If you have selected a function which you had previously defined, then the view box contains the definition of the function.

The Start Fitting and Select Dataset Buttons

Click these buttons to open the **Fitting Session** and **Select Dataset** dialog boxes, respectively.

The More Button

Click this button to switch from the basic to the advanced mode.

The New Button

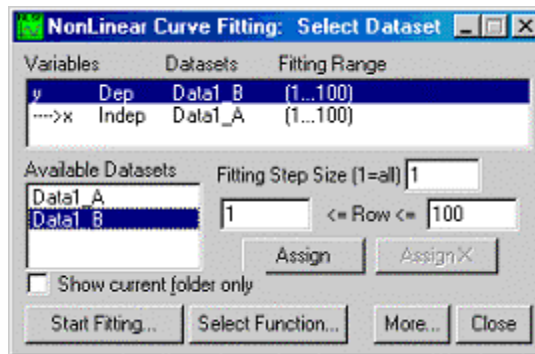
Click this button to open the **Define New Function** dialog box.

The Edit Button

Click this button to open the **Edit Function** dialog box.

Basic Mode: The Select Dataset Dialog Box

Edit the **Select Dataset** dialog box to select the data sets for fitting.

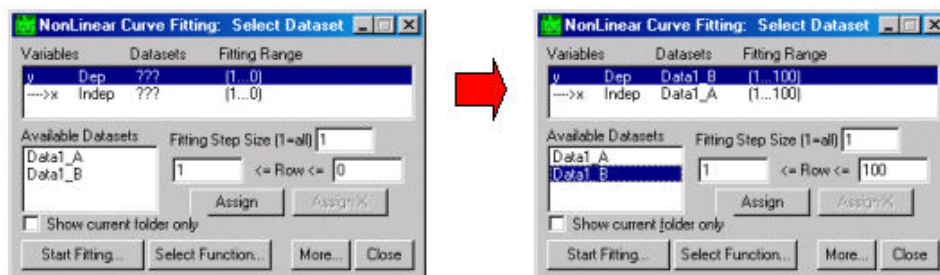
Select Dataset Dialog Box ControlsThe Variables:Datasets List Box

Each line in this list box includes the following information:

- **VariableName**
- **Dep**(endent) or **Indep**(endent)
- **DatasetAssignment**,
- **FittingRange**

VariableName is the name of the variable. *Indep* or *Dep* specifies whether the variable is independent or dependent. *DatasetAssignment* is the name of the data set to which the variable is assigned. *FittingRange* is the data set range used in fitting.

If no data set assignment has been made, the associated section of the line displays question marks. This field updates during data set assignment.



The Available Datasets List Box

This list box displays the names of all the data sets in the project.

The Assign/Assign X Buttons

You must assign all the variables to data sets.

The way in which you assign variables to data sets differs depending on whether you are assigning a dependent or an independent variable.

To assign dependent variables to data sets:

1. Click on the dependent variable you want to assign in the Variables:Datasets list box. The row becomes highlighted. Additionally, the Assign X button becomes unavailable.
2. Click on the data set name you want the variable assigned to in the Available Datasets list box. The data set becomes highlighted.
3. Click **Assign** to assign the variable to the data set.

To assign independent variables to data sets:

1. Click on the independent variable you want to assign in the Variables:Datasets list box. The Assign X button becomes available.
2. Click on a data set name in the Available Datasets list box.
3. There are now two options:

If you want the variable assigned to the data set which you highlighted in step b, click **Assign**.

If you want the variable assigned to the 'x of' the data set which you highlighted in step b (rather than to the data set itself), click **Assign X**. The 'x of' a data set may have three different meanings: another data set; the data sets associated row numbers, or a defined starting value and a step increment.

The Fitting Step Size Text Box

Specify whether you want to skip some points in fitting in this text box. For example, type **3** to use every third point in the data set. Type **1** to use all the data points.

The <= Row <= Text Boxes

If a dependent variable is highlighted in the Variables:Datasets list box, use <= **Row** <= text boxes to specify the *interval of data set rows* to be used in fitting.

If an independent variable is highlighted in the Variables:Datasets list box, then the space between the two <= signs turns into a button. You can toggle the words **Row** or *<name of variable>* on this button.

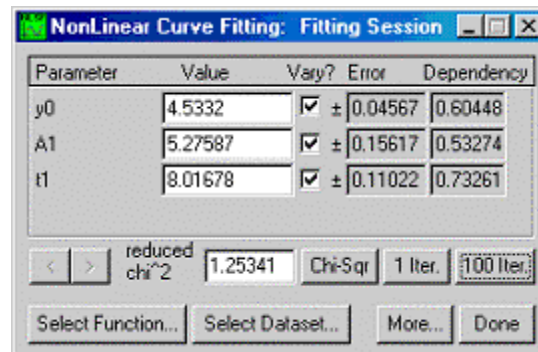
If **Row** is selected, the meaning is the same as for dependent variables.

If the name of the independent variable is displayed on the button, specify the *interval in units of the independent variable* to be used for fitting. For example, if you have specified $3.1 \leq x \leq 9.7$, this means that only the points with the value of the independent variable X between 3.1 and 9.7 will be used in fitting.

Basic Mode: The Fitting Session Dialog Box

Access this dialog box by clicking the **Start Fitting** button from the **Select Function** or **Select Data Set** dialog boxes in the basic mode.

Fitting Session Dialog Box Controls



The (Parameter) Value Text Boxes

These text boxes list the fitting parameters and their current values. Use them to specify what parameter values you want the iterative procedure to start from. Additionally, change the parameter values at any time to enable the iterations to proceed from these new values.

The Vary Check Boxes

Each parameter contains a **Vary** check box. Select this check box to vary the parameter value during the iterative procedure. Otherwise, the parameter remains fixed at its current value.

The Error List Boxes

If at least one iteration has been done, these list boxes contain the estimates of the standard errors.

The Dependency List Boxes

These list boxes display the parameter dependency. If the equation is overparameterized, there will be mutual dependency between parameters. If this value is close to one, there is strong dependency.

The Chi-Sqr Button

Click **Chi-Sqr** to display the reduced chi² value for the current parameter values. The display of this value is automatically updated after each iteration. You may use this button if you have manually changed some parameter values and want to know what the reduced chi² value is before proceeding.

The 1 Iter(ation) Button

Click **1 Iter** to perform one iteration. The new parameter values are displayed in the Parameter Value text box, together with the error and dependency values.

The *n* Iter(ations) Button

Click ***n* Iter** to cause the fitter to perform, at most, *n* iterations. The number *n* can be changed in the advanced mode. The fitter may perform less than *n* iterations if it detects that further iterations will not improve the fit. Stop the iterations at any time by pressing the ESC key.

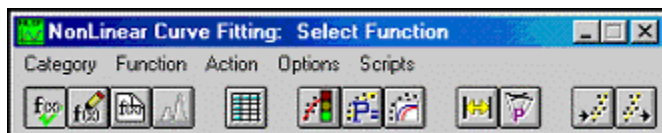
The < and > Buttons

These buttons enable you to retrieve the values of parameters which the fitter has already gone through. For example, click the < button to display the parameter values that were current before the last iterations.

Using the Fitter in the Advanced Mode

Some General Notes on the Advanced Mode of the NLSF

The fitting menu bar includes five menus: **Category**, **Function**, **Action**, **Options**, and **Scripts**. Each of these menus contain several commands. In most cases, when a menu command is selected, the dialog box associated with the menu command is displayed in the fitting window.



In addition, a fitting toolbar containing twelve buttons displays below the menu bar. Each button is associated with a menu command and can be clicked on to open the respective dialog box. You can toggle the toolbar on and off by (de)selecting **Options:Toolbar** from the fitter's menu.

Menu commands (and the corresponding toolbar buttons) may be temporarily disabled. For example, you cannot select the **Action:Fit** menu command unless you have already selected or defined a fitting function.

The menu command corresponding to the dialog box currently displayed in the fitting window is checked.

The fitting dialog boxes contain buttons, text boxes, drop-down lists, check boxes, and list boxes. Settings in one dialog box often reflect settings in other dialog boxes. For example, you can initialize parameters in the Initializations dialog box. If you then select **Action:Fit**, the parameter values displayed in the Fitting Session dialog box reflect those set in the Initializations dialog box.

Tutorial: Defining your own Function of Two Variables in the Advanced Mode

This tutorial teaches you how to define your own function of *two* variables to fit sample data sets using the advanced mode of Origin's NLSF. You will write and compile your function using Origin C. The function to be defined is:

$$\text{act} = \text{vm} * \text{substr} / (\text{km} + (1 + \text{inhib} / \text{k}) * \text{substr})$$

Opening a Project File

1. Click the Open button on the Standard toolbar to open the Open dialog box. Select 'Project (*.OPJ)' from the Files of Type drop-down list.
2. In the Origin TUTORIAL folder, double-click on FITEXMP3.OPJ in the list of files. This opens the Fitexmp3 project with the Graph1 window displaying sample data.

Starting the Fitter

1. Select **Analysis:Non-linear Curve Fit:Advanced Fitting Tool** to open the NLSF window.
2. If the basic mode of the fitter is displayed, click More to proceed to the advanced mode.

Defining a Function

1. Select **Function:New** from the fitter's menu. This menu command opens the Define New Function dialog box.
2. Type **Tutorial** in the Name text box.
3. Select the User Defined Param. Names check box to enable arbitrary parameter names.
4. Type the following in the Parameter Names text box: **ki,km,vm**. Origin will fit these parameters during the fitting session.
5. Type **substr,inhib** in the Independent Var text box. You must use these names for the independent variables when entering the function definition.
6. Type **act** in the Dependent Var text box. You must use this name for the dependent variable when entering the function definition.
7. In the Definition edit box enter the following two commands which define the function:

```
double mix = inhib / ki;  
act = vm * substr / (km + (1 + mix) * substr);
```

Note: C-language syntax requires that you declare variables prior to use. In this case, we use the statement "**double mix = inhib / ki;**" to both declare and define the variable "**mix**." The other variables and the parameters in these two equations are declared automatically because we typed them into the **Parameter Names**, **Independent Vars.** and **Dependent Vars.** text boxes in the **Edit Function** dialog box.

8. Verify that the **Use Origin C** check box is selected.
9. From the NLSF menu, select **Scripts: After Fit**. In the Fit Curve group, select **Same X as Fitting Data**. This is necessary because the x variable is not a continuous variable.
10. Verify that the **Generate Fit Curve** and **Paste Parameters to Plot** check boxes are selected.
11. From the NLSF menu, select **Function:Save**. This saves the function along with our settings, for future use.

Assigning Variables to Data Sets

1. Select **Action:Dataset** from the fitter's menu. This menu command opens the Select Dataset dialog box.
2. In the Variables:Datasets list box, click on the Act dependent variable to highlight it.
3. In the Available Datasets list box, click on **data1_activity** to highlight it.
4. Click Assign to assign the dependent variable Act to the data set **data1_activity**.
5. In the Variables:Datasets list box, click on the Substr independent variable to highlight it.
6. In the Available Datasets list box, click on **data1_substrate** to highlight it.
7. Click Assign to assign the independent variable Substr to the data set **data1_substrate**.
8. In the Variables:Datasets list box, click on the Inhib independent variable to highlight it.
9. In the Available Datasets list box, click on **data1_inhibitor** to highlight it.
10. Click Assign to assign the independent variable Inhib to the data set **data1_inhibitor**.

Entering a Fitting Session

1. Select **Action:Fit** from the fitter's menu. This menu command opens the Fitting Session dialog box.

Initializing the Parameters

1. Type **0.01** in the Value text box for the parameter ki.
2. Type **1** in the Value text box for the parameter km.
3. Type **100** in the Value text box for the parameter vm.
4. To enable all three parameters to vary during fitting, make sure that the Vary check boxes are all selected.

Fitting the Data

1. Click **100 Iter**. The actual number of iterations performed is likely to be less than 100 because a satisfactory fit can be reached with fewer than 100 iterations. You can convince yourself that this is the case by clicking on the 1 Iter button to perform one more iteration. If you do that, the reduced chi² value does not change.

Pasting the Parameter Values to the Graph and Exiting the Fitter

1. Click **Done**.

Tutorial: Fitting Multiple Data Sets to a Function in the Advanced Mode

This tutorial teaches you how to fit multiple data sets to a function using the advanced mode of the NLSF. The function used is Gaussian:

$$y=y_0 + (A/(w*\sqrt{PI/2}))*\exp(-2*((x-xc)/w)^2) .$$

Opening a Project File

1. Click the Open button on the Standard toolbar to open the Open dialog box. Select 'Project (*.OPJ)' from the Files of Type drop-down list.
2. In the Origin TUTORIAL folder, double-click on FITEXMP4.OPJ in the list of files. This opens the Fitexmp4 project with the Graph1 window displaying sample data.

Starting the Fitter

1. Select **Analysis:Non-linear Curve Fit:Advanced Fitting Tool** to open the NLSF window.
2. If the basic mode of the fitter is displayed, click More to proceed to the advanced mode.

Selecting a Function

1. Select **Function:Select** to open the Select Function dialog box.
2. Click on Origin Basic Functions in the Categories list box.
3. Click on Gauss in the Functions list box. This action selects a Gaussian function.

Selecting Multiple Data Sets

1. Select **Action:Dataset** to open the Select Dataset dialog box.
2. Select the Fit Multiple Datasets check box.
3. Click *twice* on the Add Data button to indicate that you want to fit simultaneously *three* data sets to the same function.
4. Click on the x(1) independent variable in the Datasets:Variables list box at the top of the dialog box to highlight it.
5. Click on the **data1_a** data set name in the Available Datasets list box to highlight it.
6. Click Assign to assign the independent variable x(1) to the **data1_a** data set.

7. Repeat the same procedure with the independent variables $x(2)$ and $x(3)$ to assign them to the same **data1_a** data set.
8. Click on the $y(1)$ dependent variable in the Datasets:Variables list box at the top of the dialog box to highlight it.
9. Click on the **data1_b** data set name in the Available Datasets list box to highlight it.
10. Click Assign to assign the dependent variable $y(1)$ to the **data1_b** data set.
11. Repeat the analogous procedure for the dependent variable $y(2)$ to assign it to the **data1_c** data set and for the dependent variable $y(3)$ to assign it to the **data1_d** data set.

Specifying Parameter Sharing

1. Double-click on the w and A parameters in the Parameter Sharing list box to tag them as shared. This causes only one “version” of each of these two parameters to be used for all three data sets, whereas each data set will have its own “version” of the remaining two parameters.

Fitting the Data

1. Select **Action:Fit** to open the Fitting Session dialog box.
2. Leave the initial parameter estimates as they are. Note that for built-in fitting functions, Origin calculates data set specific parameter estimates. This is done automatically when you choose **Action:Fit** from the NLSF menu.

Note also that only one value is listed for w and A parameters because we chose to share those parameter values among the three data sets.

3. Make sure that all the parameters have their Vary check boxes selected to allow them to vary during fitting.
4. Click 100 Iter.

Pasting the Results to the Graph and Exiting the NLSF

1. Click Done.

To Expedite Future Fitting Sessions using the Same Fitting Function and Similar Data

Note that the NLSF will remember which fitting function was last used.

1. Activate the worksheet that contains the data that you want to fit.
2. Highlight the data sets.
3. Select **Analysis: Non-linear Curve Fit:Advanced Fitting Tool**. The fitting function is selected and the data sets are assigned automatically. When you select **Action:Fit** the parameters are automatically initialized. You can now start fitting.

Before you Start: The Chi-Square Minimization

Two building blocks of any fitting procedure are:

- The data which represent the results of some measurements in which one or several *independent* (input) variables (x_1, x_2, x_3, \dots) were varied over a certain range in a controllable manner so as to produce the measured *dependent* (output) variable(s) y_1, y_2, y_3, \dots .

- The mathematical expression (a function or a set thereof) in the form

$$y_1 = f_1(x_1, x_2, x_3, \dots; p_1, p_2, p_3, \dots) \quad y_2 = f_2(x_1, x_2, x_3, \dots; p_1, p_2, p_3, \dots)$$

$y_3 = f_3(x_1, x_2, x_3, \dots; p_1, p_2, p_3, \dots)$ which represents the theoretical model believed to explain the process that produced the experimental data. The model usually depends on one or more parameters p_1, p_2, p_3, \dots .

The aim of the fitting procedure is to find those values of the parameters which best describe the data. The standard way of defining the best fit is to choose the parameters so that the sum of the squares of the deviations of the theoretical curve(s) from the experimental points for a range of independent variables...

$$\chi^2(p_1, p_2, \dots) = \frac{1}{n^{\text{eff}} - p} \sum_i \sum_j w_{ji} [y_{ji} - f_j(x_{1i}, x_{2i}, \dots; p_1, p_2, \dots)]^2$$

... is at its minimum. Here, y_{ji} are the measured values of the dependent (output) variable y_j for the values of the independent (input) variables $x_1 = x_{1i}, x_2 = x_{2i}, \dots$; n^{eff} is the total number of experimental points used in the fitting, and p is the total number of adjustable parameters used in the fitting (the difference $d = n^{\text{eff}} - p$ is usually referred to as the number of degrees of freedom). The quantities w_{ji} represent the weights of each experimental point.

Origin supports five weighting methods:

- No weight: $w_{ji} = 1$.
- Instrumental weights: $w_{ji} = 1/\sigma_{ji}^2$, where σ_{ji} are the error bar sizes stored in error bar columns.
- Statistical: $w_{ji} = 1/y_{ji}$.
- Any data set: The weights are determined by any user-specified data set so that $w_{ji} = 1/c_{ji}^2$, where c_{ji} are the values of arbitrary data sets.
- Direct: $w_{ji} = c_{ji}$.

In case there is only one independent and one dependent variable:

$$y = f(x, p_1, p_2, p_3, \dots)$$

the expression for χ^2 simplifies to:

$$\chi^2(p_1, p_2, \dots) = \frac{1}{n^{\text{eff}} - p} \sum_i w_i [y_i - f(x_i, p_1, p_2, \dots)]^2$$

The LM algorithm, starting from some initial parameter values, minimizes $\chi^2(p_1, p_2, \dots)$ by performing a series of iterations on the parameter values and computing $\chi^2(p_1, p_2, \dots)$ at each stage. In order to do

that, Origin internally calculates partial derivatives $f_j = \left[\frac{\partial f}{\partial \phi_1}, \frac{\partial f}{\partial \phi_2}, \dots, \frac{\partial f}{\partial \phi_n} \right]$ for all the values of the input variables. For built-in functions, all the derivatives are computed using analytic expressions. For user-defined functions, the partial derivatives are computed numerically. The computation is thus faster for built-in functions than for user-defined functions. (Note: You can define a user-defined function with partial derivatives.)

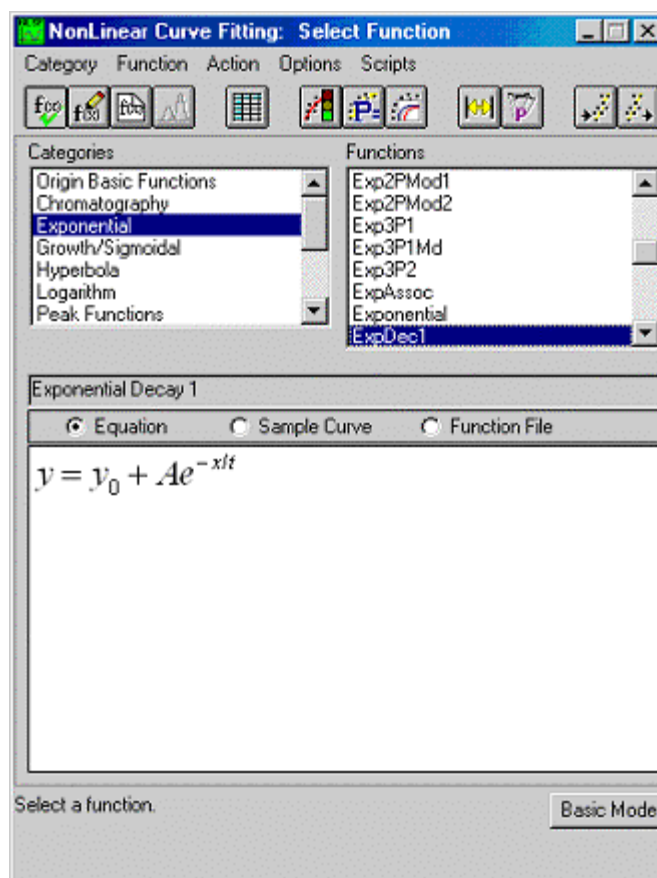
You can limit the set of the allowed values which the fitting parameters can take during the iterative procedure by imposing linear constraints. Origin internally implements the constraints by means of the Lagrange multiplier method.

Note: The NLSF always reports the reduced χ^2 value, not χ^2 . In some locations of the NLSF, reduced χ^2 is labeled " χ^2 ". In other locations, it is labeled " χ^2/DoF ". In all cases the actual value is reduced χ^2 .

Selecting an Existing Fitting Function

Select **Function:Select** to select a built-in or previously saved user-defined function for fitting. This menu command opens the Select Function dialog box.

The Select Function Dialog Box



The Categories List Box

Select the desired category in this list box. Origin provides a variety of built-in functions. Functions are grouped into several categories based on the area of primary use.

The Functions List Box

Functions belonging to the selected category are displayed in this list box. The listed functions include both built-in and user-created functions. Click to select the desired function.

Select **Function:Add** to add a function to the selected category.

Select **Function:Delete** to remove the highlighted function from the list.

The Equation Radio Button

Select the **Equation** radio button to display the function in the lower view box. The radio button is unavailable if a user-defined function is selected.

The Sample Curve Radio Button

Select the **Sample Curve** radio button to display a sample curve of the currently selected function. The curve is displayed in the lower view box. The radio button is unavailable if a user-defined function is selected.

The Function File Radio Button

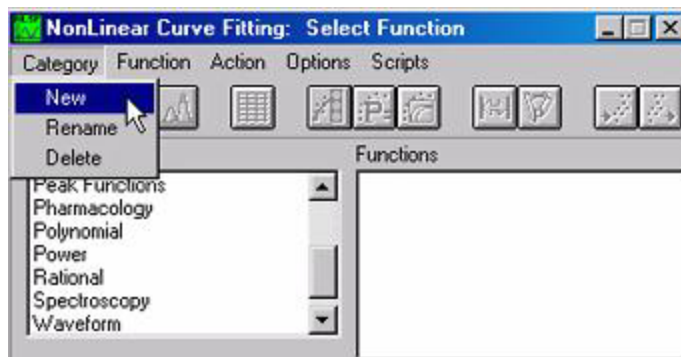
Select the **Function File** radio button to display the function definition file associated with the function. The function definition file contains all the information about the function and the current fitting session. *It is not necessary to view this file.* In fact, most of the contents of this file can be changed using other dialog boxes.

Note: To learn more about fitting with a built-in function, review the NLSF BUILT IN FUNC.OPJ project located in your Origin \SAMPLES\ANALYSIS\CURVE FITTING folder.

User-Defined Fitting Functions

Adding a new Category

New functions can be added to existing categories, or they can be added to a new category. To create a new category before defining a new fitting function.

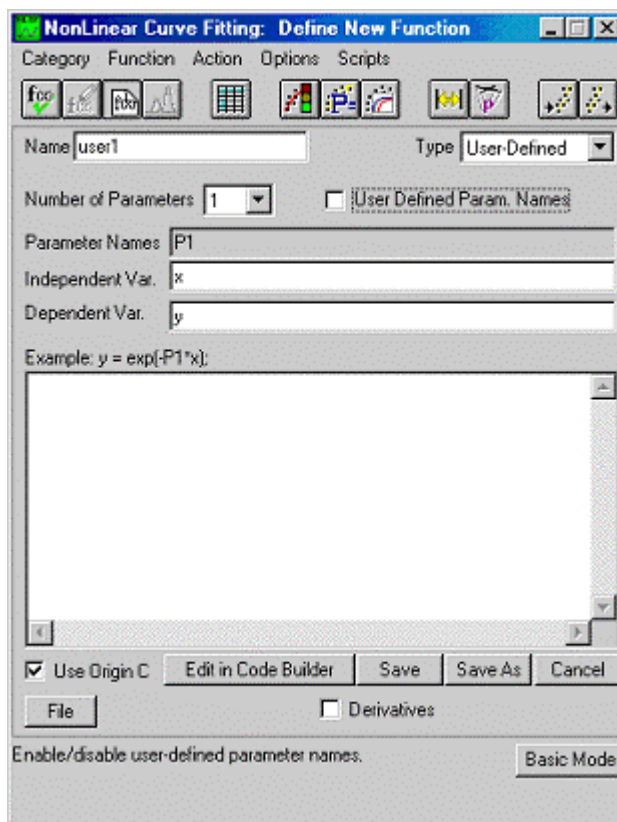


1. From the Origin program menu, select **Analysis:Nonlinear Curve Fit:Advanced Fitting Tool**.
2. From the NLSF menu, select **Category:New**.
3. In the Category Name text box, type **Category Name** (spaces are permissible) and click **OK**.

Defining a New Function

To define a new function, choose **Function:New** from the NLSF menu.

The Define New Function Dialog Box



The **Name** Text Box

The **Name** text box will display a default name, such as user1. Enter the name of your function.

When you save a user-defined function, it is stored in the Origin\FitFunc folder as *FunctionName.FDF*.

Note: The function name *must not contain spaces or special characters*. Failure to adhere to function naming conventions will generate a warning.

The **Type** Drop-Down List

The **Type** drop-down list offers two choices: **User-Defined** and **External DLL**. The default type – the appropriate choice in most cases – is **User-Defined**.

The **External DLL** option gives the user access to a function that is coded and compiled using a non-native compiler (such as a C or FORTRAN compiler). This method predates Origin C and, as such, is perhaps less attractive. However, the option is provided for purposes of backward compatibility.

The Number of Parameters Drop-Down List

By default, Origin assigns names of **P1**, **P2**, etc., to function parameters. For example, setting the **Number of Parameters** drop-down to **3**, generates the parameter names of **P1**, **P2**, and **P3**.

If you opt for user-defined parameter names, it is *not* necessary to set the Number of Parameters drop-down list.

The User Defined Param. Names Check Box.

This check box must be selected if you specify your own parameter names.

The Parameter Names Text Box

If default parameter names are used, this text box is not editable. It is only editable when the **User Defined Param. Names** checkbox is selected.

Note: *The following user defined parameter names are not allowed:* $x_1, x_2, \dots, x_n, y_1, y_2, \dots, y_n, z_1, z_2, \dots, z_n$. The letters i, t, j, and e are not allowed for either user-defined parameters or variables. Furthermore, there are some system variables that should be avoided. For more information on these system variables, consult the LabTalk Language Reference section of the Programming Help file (**Help:Programming**). You are strongly encouraged to *choose parameter and variable names that contain more than one character*. If you use a name that is not allowed, you will be prompted to change it when you start fitting.

The Independent Var. Text Box

Specify the name(s) of the independent variable(s), using comma separators as needed. Note that the NLSF allows more than one independent variable.

See the note above concerning parameter and variable names.

The Dependent Var. Text Box

Specify the name(s) of the dependent variable(s), using comma separators as needed. Note that NLSF allows more than one dependent variable.

See the note above concerning parameter and variable names.

The Definitions Text Box

The function definition is typed into this text box. If you define your function using Origin C (the **Use Origin C** check box is selected), it may be more convenient to use the Code Builder workspace to type your function. Refer to the **Edit in Code Builder Button** section below for more details. Once you have defined your function in Code Builder, you can do further editing in the **Definitions** text box.

If the Use Origin C check box is *cleared*, you must type the function in the **Definitions** text box. This applies to all forms (**Expressions**, **Y-Script**, or **Equations**) available from the **Form** drop-down list.

The Use Origin C Check Box

When defining a new function, the NLSF default setting is to use Origin C, Origin's ANSI C-compatible programming language. This option offers the most speed and flexibility for defining your function.

When the **Use Origin C** check box is selected, the **Form** drop-down list is unavailable.

The Form Drop-down List

The available function forms are **Expression**, **Y-Script**, and **Equations**.

- **Expression.** Use is limited to function definitions with a *single dependent variable*. The function definition follows the form of this example:

$$a*x+b*x^2+\exp(c*x)$$

- **Y-Script.** Use this form when using LabTalk script to define your function. Each dependent variable must be defined in the script using the form...

$$y = \dots$$

where y is the dependent variable.

- **Equations.** This option is appropriate for one or more dependent variables. Define your function in Definitions text box. For multiple dependent variables, type a separate line for each following the form of this example:

$$y1 = \dots$$

$$y2 = \dots$$

where y1 and y2 are dependent variables. Do not include any loops or if-else clauses. Temporary variables are permissible.

Note 1: When the Use Origin C check box is selected, the **Form** drop-down list is unavailable. In actuality, both **Y-Script** and **Equations** forms will work with Origin C. Only the **Expression** form is incompatible.

Note 2: If your function definition uses constants and the constant values are not specified in the function definition itself, they must be assigned in the Constants text box of the Initialization dialog box (choose **Scripts:Parameter Initialization** from the NLSF menu).

The Edit in Code Builder Button

This button is available when Use Origin C is enabled. Clicking this button opens a specialized version of the Code Builder workspace.

This specialized Code Builder window will open with an active window named `_nlffunctionName.fit` (`_nlfAsymmetricGaussian.fit`, in this example). This is the edit window for the new function definition.



The first few lines of code are `#include` statements that identify various header files required for compiling the fitting function. The actual function definition begins with the statement:

```
void _nlAsymmetricGaussian(...
```

The parameters, independent variables, and dependent variables are declared at the beginning of this function definition. After these declarations, there is an editable section – the area bounded in white – that is reserved for entering your function definition.

The above figure shows the definition of the asymmetric Gaussian function having been typed in. Note that the function definition must comply with C programming language syntax. For instance, *the parameters and all variable types are case sensitive*. Intermediate variables – such as `B` in this example – *must be declared first* using a statement such as:

```
double B;
```

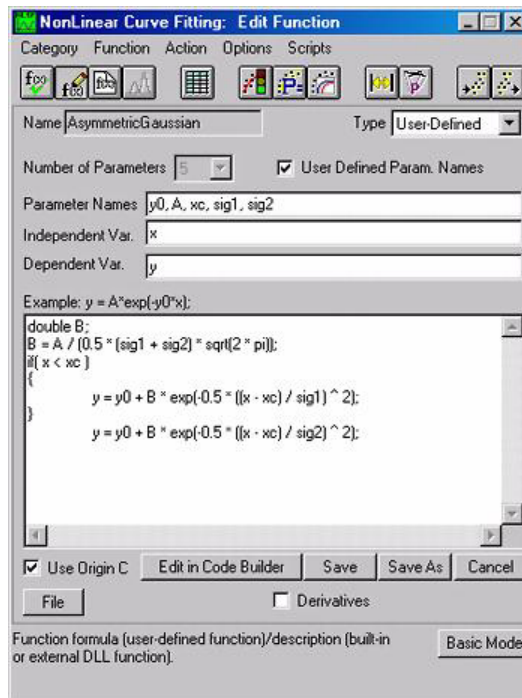
This declaration must occur before the variable is used in the function definition.

Note that the function is of type `void`, which means that no values are returned by the function. Instead, the dependent variable value is set inside the function code. In our example, the dependent variable `y` is assigned a different value, dependent upon whether `x` is less than or greater than the centroid parameter, `xc`.

Once the function is defined, you must verify that your syntax is correct. To test, click the **Compile** button at the top of the Code Builder workspace. This action compiles the function code using Origin C. Any errors generated in the compiling process are reported in the Code Builder output window at the bottom of the workspace. This window also reports when a file has successfully compiled (see the above figure).

Once the function has been defined and compiled, you can return to the NLSF interface by clicking the **Return to NLSF** button at the top of the window. This closes the specialized Code Builder window.

As mentioned, you can do further editing of your function directly in the NLSF Function Definition text box. You can also click the **Edit in Code Builder** button and return to the Code Builder workspace to edit your function.



Note: It is not necessary to close Code Builder to return to the NLSF. You can leave the Code Builder workspace open and switch between the NLSF and Code Builder. However, if you leave Code Builder open, you will not be able to edit to your function from the NLSF; the NLSF Function Definition text box will not be editable. Furthermore, if you make changes to your function in the Code Builder workspace, you should click the Compile Button so that when you switch to the NLSF, your function is updated. We recommended that you click the Return to NLSF button to close Code Builder before returning to the NLSF. If you wish to debug the function by setting break points in your code, it makes sense to leave Code Builder open. For further information on debugging, select **Help:Programming:Programming Guide...** from the Origin menu and search on **debug**.

Note that if, after defining your function in Code Builder, you click the Return to NLSF button *without* compiling your function, the function will compile automatically when you select **Action:Fit** from the NLSF menu.

The Save Button

Click the **Save** button to save the function as ***functionName.FDF***. The default folder for storing the function file is the \FitFunc subfolder in the Origin software directory. If a function of the same name already exists, the **Save As** dialog box opens and the user is asked to give the function a new name. Assigning a new name to the function will update the **Name** field in the **Function Name** text box.

Note that once you save the function file, the Function Name text box is no longer editable. To change the name of a saved function, save the function with a different name using the **Save As** button.

The Save As Button

The **Save As** button opens the Save As dialog box. The Save As button allows you to save the current function under another name. Note that choosing another name assigns this name to both the function name and the disk (.FDF) file.

If a function of the same name already exists, the user is prompted to choose a different name.

The **Cancel** Button

Click the **Cancel** button to discard function modifications made since the function file was last saved.

The **File** Button

Click the **File** button to display and/or edit the function definition file associated with the function. To return to the Edit page, click on the **Form** button.

The **Derivatives** Check Box

Specifying partial derivatives of your function can reduce the time it takes to perform a set of iterations. However, given the much-enhanced speed of fitting achieved with Origin C, specifying partial derivatives may not be necessary.

If you wish to specify partial derivatives, note that you must specify the derivatives of the function of the dependent variable in terms of the fit parameters. Furthermore, partial derivatives with respect to *all* fitting parameters need to be specified.

If you have chosen to define the function using Origin C, the variables for the partial derivatives will be pre-defined in Code Builder. You just need to enter the expression for them..

For example, if the function is:

$$y = P1 + P2 * x + \exp(P3 * x)$$

then the variables `dy_P1`, `dy_P2`, and `dy_P3` will be available, and you will need to enter the following equations for the partial derivatives:

$$dy_P1 = 1;$$

$$dy_P2 = x;$$

$$dy_P3 = x * \exp(P3 * x);$$

Note that if you *do not* use Origin C and are defining your function using LabTalk with the Form drop down list set to Y-Script (the only form that is compatible with use of derivatives), then the notation for partial derivatives is different. In this case, the partial derivatives for the above example would be:

$$y'P1 = 1;$$

$$y'P2 = x;$$

$$y'P3 = x * \exp(P3 * x);$$

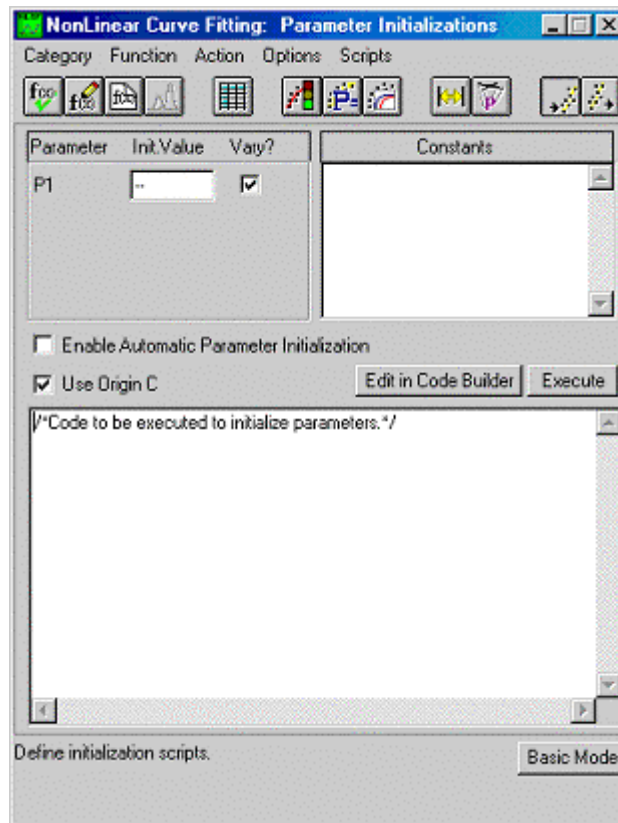
Defining Parameter Initialization Code

Good parameter initialization results in fast and reliable model/data convergence. Automatic parameter initialization can effectively approximate parameter values prior to fitting by generating dataset-specific parameter estimates.

The NLSF provides automatic parameter initialization code for all built-in functions. For user-defined functions, you must add your own parameter initialization code. If no parameter initialization code is provided, then the NLSF registers all parameter values as missing values. If parameter values are missing, you must enter “guesstimate” parameter values to start the iterative fitting process.

To open the parameter initializations dialog, choose **Scripts:Parameter:Initialization** from the NLSF menu.

The Parameter Initializations Dialog Box



The Parameters Group

This group contains the parameter name, an editable text box with current parameter value and a check box control for varying or fixing the parameter value during the iterative fitting process.

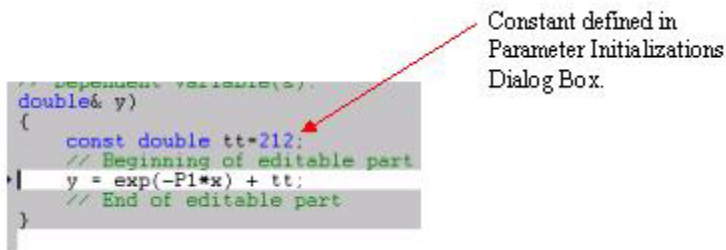
Until the fit dataset is assigned and the automatic parameter initialization code is executed, the parameters will register as missing values. The **Vary** check box is checked by default.

The Constants Text Box

If your function definition contains constants (not to be confused with parameters and variables), you will need to define those constants in this text box, using this format:

```
constant1 = value1;
constant2 = value2;
```

When using Origin C to define your function, any constant you specify in this text box will appear in the function body when you edit/view the function in Code Builder. You should define your constants in this text box before editing your function in Code Builder. This will ensure that your constants appear in your function definition.



If you are defining your function using LabTalk, with the Form drop-down set to Y-Script, then the constant(s) you specify in this text box will be available for use in your function definition script.

You can also use externally defined constants in your Y-script function (e.g., constants defined in the script window). In such cases, you can use the constant in your function definition script, and later assign values to the constant in the Constants text box.

There same naming restrictions apply to constants as apply to parameter and variable names: $x_1, x_2, \dots, x_n, y_1, y_2, \dots, y_n, z_1, z_2, \dots, z_n$, and the letter *i* are *not allowed*. The letters *t, j, and e* should also be avoided. Furthermore, there are some system variables that should be avoided. For more information on these system variables, consult the LabTalk Reference section of the Programming Help file (**Help:Programming => LabTalk Language Reference**). You are strongly encouraged to *choose constant names that contain more than one character*.

The Enable Automatic Parameter Initialization Check Box

This check box determines whether automatic parameter initialization code is executed when you choose **Action:Fit** from the NLSF menu. This setting is saved with each function file. If this check box is *cleared*, then the user needs to click the **Execute** button to run the initialization code. For new functions, this check box is cleared by default. For built-in functions, this check box is selected by default, but can be cleared at your discretion.

Note: If data sets for fitting are not assigned, the parameter initialization code will fail to execute.

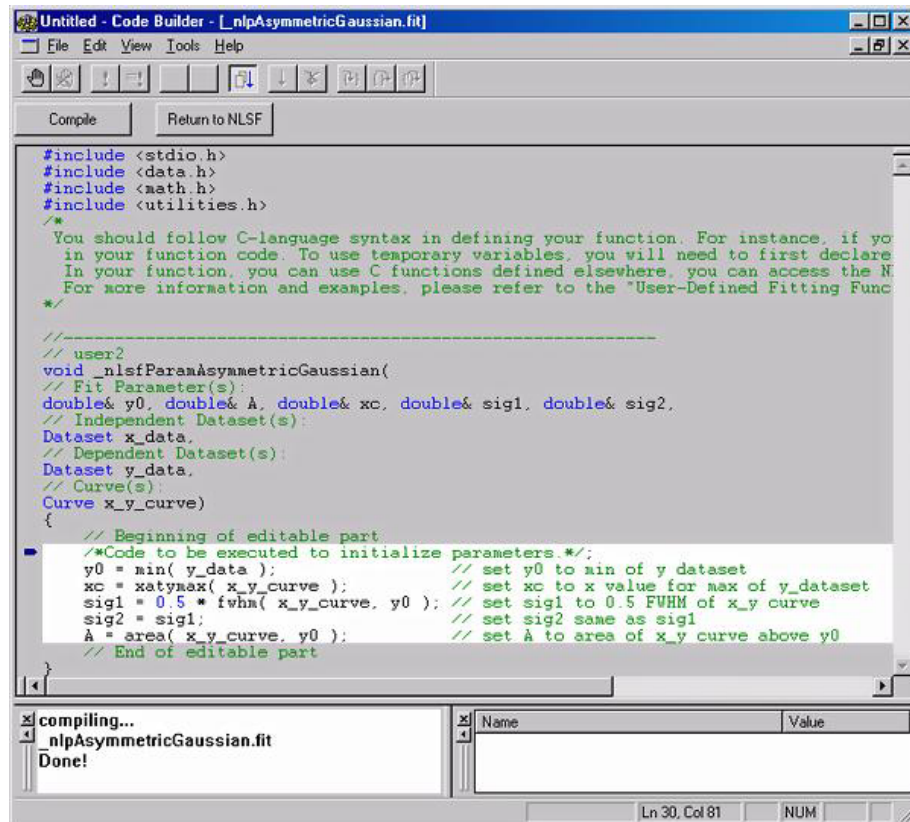
The Use Origin C Check Box

When you create a new function, this check box is selected by default. When this check box is selected, parameter initialization code must be defined using Origin C.

If this box is *cleared*, the parameter initialization code is interpreted as LabTalk script. Leaving the check box selected (using Origin C) optimizes parameter initialization.

The Edit In Code Builder Button

This button is available when the user has selected the Use Origin C check box. Clicking the button opens a specialized version of the Code Builder workspace. This workspace will open with an active window named `_nlpfunctionName.fit` (`_nlpAsymmetricGaussian.fit`, in [this example](#)). This is the edit window for the parameter initialization code.



The first few lines of code are `#include` statements that identify various header files required for compiling the initialization code. The initialization function starts with the statement (for this example):

```
void _nlsfParamAsymmetricGaussian(...
```

The parameters, independent variables, and dependent variables are declared at the beginning of this function definition. In addition to these, a few other Origin objects are also declared. A Dataset object is declared for each of the independent and dependent variables. A Curve object is declared for each xy data pair.

```
Dataset x_data,
```

```
Dataset y_data,
```

```
Curve x_y_curve
```

The Dataset objects point to the x and y data sets for which you are trying to find a best fit. Therefore, the Dataset objects should be used in the initialization code without performing any modifications to them; modifications of the Dataset objects will alter the dataset to be fit.

The Curve object is a copy of the dataset curve that results from pairing an x and a y dataset. You can manipulate this Curve copy in the initialization code without affecting the fit dataset. Many Origin C functions take the Dataset or the Curve as an argument and return potentially useful properties (as, for instance, assigning initial parameter estimates in the initialization code).

Below these declaration statements, there is an editable section – the area bounded in white – that is reserved for entering the initialization code. The above figure shows some parameter initialization code for the asymmetric Gaussian function. Note that the function definition follows the requisite C syntax. Note, also, that the function is of type `void`, which means that our function returns no values. Instead, the parameter variables are stored in the function code. The

y0 parameter is initialized using the minimum value of the y dataset, the xc parameter is initialized using the x value that corresponds to the maximum y value (centroid of the peak in the data) etc.

Initialization is accomplished by calling built-in functions that take a dataset or a curve object as an argument. Such functions are prototyped in the data.h header file and the C code for these functions can be found in the file internal.c, in OriginC\System subfolder.

Once the initialization function is defined, you should verify that the syntax is correct. To do this, click the Compile button at the top of the workspace. This compiles the function code using Origin C. Any errors generated in the compile process are reported in the Code Builder Output window at the bottom of the workspace. The Output window reports that the compilation is successful. (see the above image).

Once the initialization code has been defined and compiled, you can return to the NLSF interface by clicking on the Return to NLSF button at the top of the workspace. This will close Code Builder and return you to the NLSF interface. From there, you can do further editing of your code in the Initialization Code text box or you can click the Edit in Code Builder button again to launch Code Builder.

Note: It is not necessary to close Code Builder to return to the NLSF. You can leave the Code Builder workspace open and switch between the NLSF and Code Builder. However, if you leave Code Builder open you will not be able to edit to your code from the NLSF; the Initialization Code text box will not be editable. Furthermore, if you make changes to your code in the Code Builder workspace, you should click the Compile Button so that when you switch to the NLSF, your code is updated. We recommended that you click the Return to NLSF button to close Code Builder, before returning to the NLSF. If you wish to debug your code by setting break points, it makes sense to leave Code Builder open. For further information on debugging, select **Help:Programming:Programming Guide...** from the Origin menu and search on **debug**.

The Execute Button

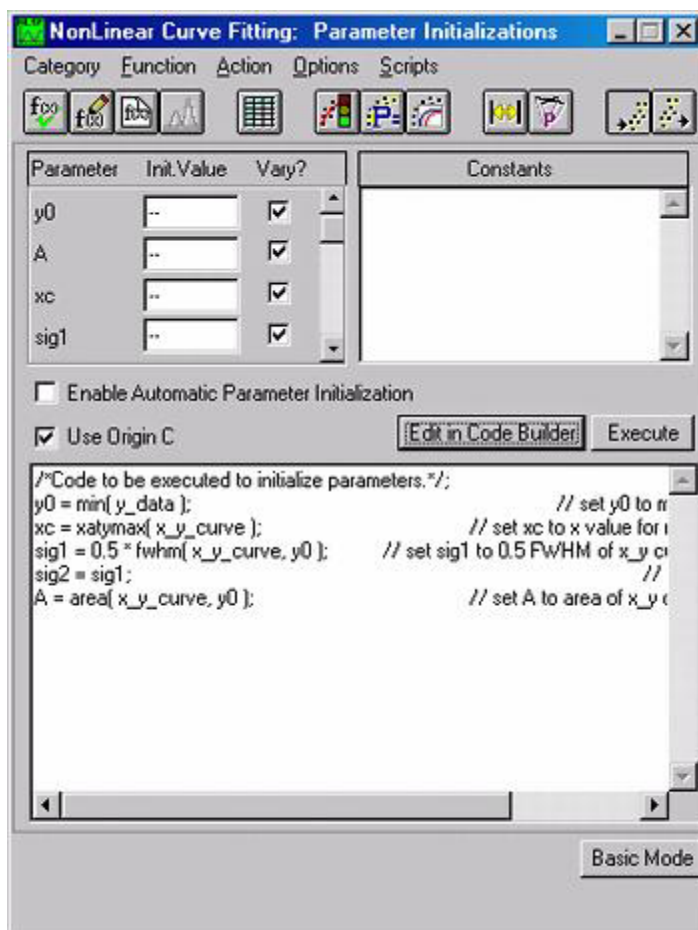
Click the **Execute** button as needed to execute the parameter initialization code and assign parameter values. Normally, when a function with parameter initialization code is used (and the **Enable Automatic Parameter Initialization** check box is selected), the initialization code runs automatically when the iterative fitting process begins. The **Execute** button thus provides a means to reset the parameter values to the initial “guesstimate” values. This is useful if the fit does not converge and the user wants to adjust initial parameter values or fix (prevent from varying) a parameter value. Additionally, you might change the initialization code itself, then click the Execute button to recompute initial parameter values.

Note 1: If Automatic Parameters Initialization is enabled, adjustments to parameters will be overwritten when you select **Action:Fit**, unless you have changed the initialization code itself.

Note 2: If data sets for fitting are not assigned, the parameter initialization code will fail to execute.

The Initialization Code Text Box

This text box contains the parameter initialization code. The code can be edited in this text box, or it can be edited in Code Builder by clicking on the **Edit in Code Builder** button. If you make changes to the code in this text box, you can click the **Execute** button to compile and execute the code. Compilation errors will produce an “Error during compilation” message in the status area at the bottom of the NLSF interface.



Saving the Parameter Initialization Code

When you have defined your parameter initialization code, select **Function:Save** from the NLSF menu. This saves the fitting function with the parameter initialization code, to a fitting function (.FDF) file.

You can also save the function using the **Save** or **Save As** buttons on the **Function:Edit** page.

Fitting with the User-defined Function

Once you save the user-defined function, you can use it in the same way that you use a built-in curve fitting function. To read more about how to use an existing function, please see *Selecting an Existing Fitting Function* on page 525.

Accessing the NLSF Object and Properties

When you use Origin C to define your fitting function and/or your parameter initialization code, you can access the NLSF object and its properties. For instance, you might use...

```
LabTalk.NLSF.Func$ = "Gaussian";
```

...to set your fit function to Gaussian.

The Origin C `using` statement provides a short cut for accessing the NLSF object properties. Consider this function definition code example:

```
using NLSF = LabTalk.NLSF;

if(NLSF.CurrentRow < 21)
    y = P1 + P2 * x;
else
    y = P1 + P3 * x^2;
```

In this example, the current row property of the NLSF object is used to fit the first 20 rows of data with one function while the remaining data are fit with another function.

Accessing Other Origin C Functions in your NLSF Code

When you use Origin C to define your fitting function and/or your parameter initialization code, you can access Origin C functions that you have created outside of the NLSF environment.

To access these functions, do the following:

1. Add the Origin C function to your Code Builder workspace (For information, see “Working with Files” in the Code Builder User's Guide portion of the Programming Help file (**Help:Programming**)).
2. Create a header file that prototypes the function(s) that you want to access.
3. Add this header file to the `nlsf.fit` template file in your `\OriginC\NLSF` subfolder .

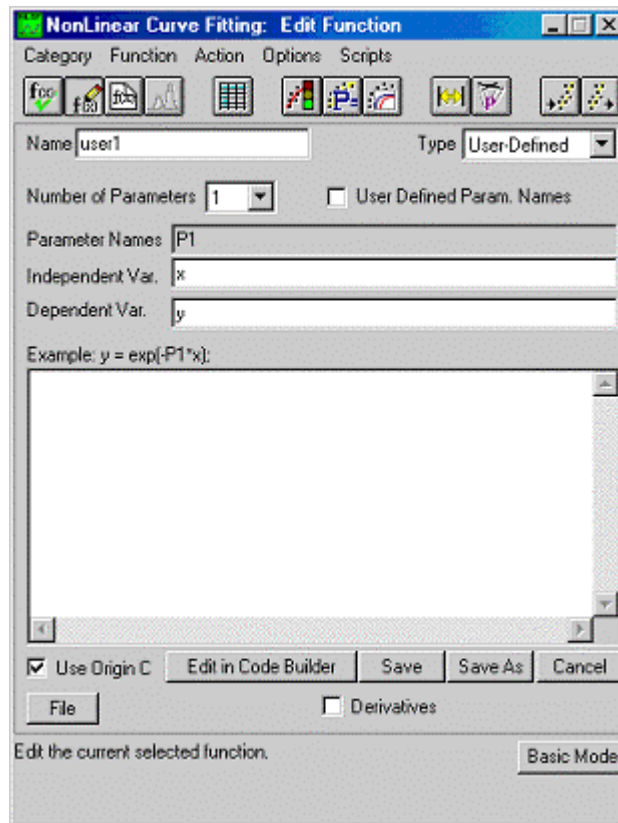
This is the method by which the parameter initialization functions are included for use in the NLSF. These functions (`min()`, `yatxmax()`, `area()` etc.) are defined in `internal.c` and are prototyped in `data.h`. The `data.h` header file is included in the `nlsf.fit` template file and so is included any time you code with Origin C in the NLSF. The `internal.c` file is a special file that the NLSF loads and adds to your workspace any time you that compile code with Origin C.

Editing the Function

The **Edit Function** dialog box is only intended for editing *user-defined* functions (for built-in functions, see note below).

Select **Function>Edit** to edit the selected function. This menu command opens the Edit Function dialog box. This menu command is not available if you have not selected or defined a function.

The Edit Function Dialog Box



The Name Text Box

When editing an existing function, the **Name** text box is not editable. To change the name of a saved function, save the function with a different name using the **Save As** button.

The Type Drop-Down List

The function type is selected from the drop-down list. Choose from **User-Defined** (default) or **External DLL**.

The Number of Parameters Drop-Down List

Select the number of fitting parameters from this drop-down list. This drop-down list is not available once the user-defined function has been saved with user-defined parameters, though the number of parameters will update if new parameters are added to the **Parameter Names** text box.

The User Defined Param. Names Check Box

Select this check box to define new names for the function parameters.

The Parameter Names Text Box

The names of the parameters are displayed in this text box. If the **User Defined Param. Names** check box is selected, you can edit your own parameter names in this text box. Otherwise, the parameter names are set by default to: P1, P2, etc. When entering parameter names in this text box, separate the names by commas.

The number of parameters selected from the **Number of Parameters** drop-down list must correspond with the number of names in this text box.

Note: If you change the parameter names you must also change the function definition in the Definition text box. Note that *the following user defined parameter and variable names are not allowed*: $x_1, x_2, \dots, x_n, y_1, y_2, \dots, y_n, z_1, z_2, \dots, z_n$, and the letter i. The letters t, j, and e should also be avoided. Furthermore, there are some system variables that should be avoided. For more information on these system variables, consult the LabTalk Language Reference section of the Programming Help file (**Help:Programming**) from the Origin menu. You are strongly encouraged to *choose parameter and variable names that contain more than one character*. If you use a name that is not allowed, you will be prompted to change it when you start fitting.

The Independent Var. Text Box

Specify the names of the independent variables in this text box. Separate parameters by commas.

The Dependent Var. Text Box

Specify the names of the dependent variables in this text box. Separate the parameters by commas.

The Description/Definition Text Box

Alter the definition of the function in the Definition text box. To learn about defining your function and compiling it using Origin C, see *Defining a New Function* on page 527.

The Use Origin C Check Box

You can define a fitting function directly in the Definition text box using Origin C code. To do this, your function must be of the form **Y-Script** or **Equation** and the **Use Origin C** check box must be selected.

If your equation is in the **Expression** form, it will not be recognizable by Origin C. To use the Origin C compiler, you will have to modify your Description to use the Equation or Y-Script form.

If you choose to select the Use Origin C check box, you can enter your Origin C code in the Definition text box, or you can use Code Builder, the Origin C development environment, to write or edit your code. To learn about editing your function in Code Builder and compiling it using Origin C, see *Defining a New Function* on page 527.

If the Use Origin C check box is *not* selected, you must type your function in the Definition text box.

The Form Drop-Down List (user-defined functions only)

Select a form for the user-defined function from the Form drop-down list. The drop-down list includes: **Expression**, **Y-Script**, and **Equations**.

Note that if you have written your function to be compiled using Origin C and the **Use Origin C** check box is selected, the **Form** drop-down list is not visible. For more information on defining your function so that it is compatible with Origin C, see *Defining a New Function* on page 527.

The File/Form Button

Click **File** to display (and edit) the function definition file associated with the function.

When the function definition file is displayed in the text box, the **Form** button is available. Click this button to exit the viewing mode of the function definition file.

The Derivatives Check Box

Specifying partial derivatives of your function can reduce the time it takes to perform a set of iterations. However, given the much-enhanced speed of fitting achieved with Origin C, specifying partial derivatives may not be necessary.

For more information on defining your function so that it is compatible with Origin C, see *Defining a New Function* on page 527.

The Save Button

Click **Save** to save the function modifications in a disk file. The file is named using the text in the **Name** text box.

The Save As Button

The **Save As** button opens the **Save As** dialog box.

The Save As button allows you to save the current function under another name. Note that choosing another name assigns this name to both the function name and the disk (.FDF) file. If a function of the same name already exists, the user is prompted to choose a different name.

The Cancel Button

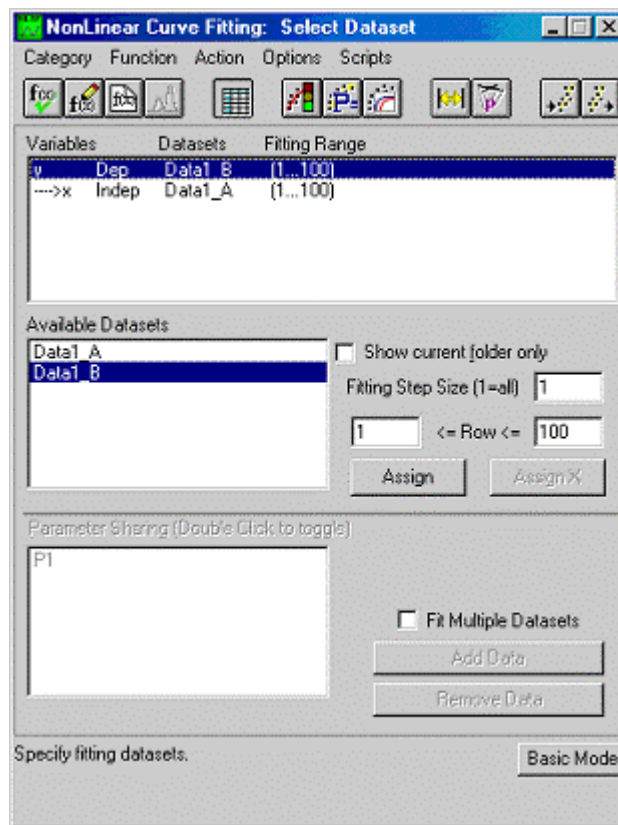
Click **Cancel** to discard the function modifications in the **Edit Function** dialog box.

Note: If you want to modify a built-in function, copy the equation in the Description text box (it is selectable, but not editable) to the Clipboard, choose **Function:New** from the NLSF menu and paste the equation into the new function Description text box. Then you can proceed to modify the equation and save it with a new name.

Selecting the Data Sets

After selecting a model for fitting, you must select the data sets for fitting and assign the function variables to the data sets. Select **Action:Dataset** to open the Select Dataset dialog box. Because the number of both the dependent and the independent variables must be known to perform the data set assignments, you must select or define function(s) *prior to entering* the Select Dataset dialog box.

The Select Dataset Dialog Box



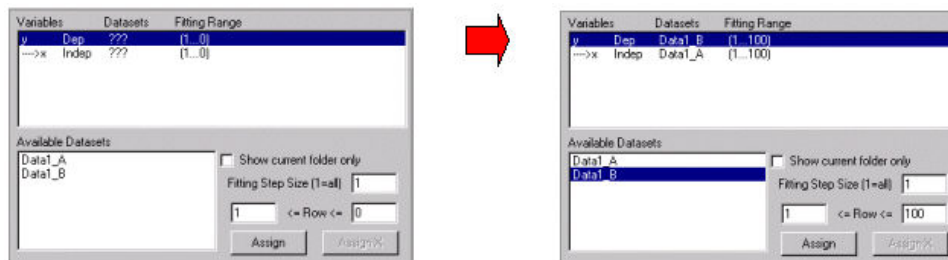
The Variables:Datasets List Box

Each line in this list box includes the following information:

- **VariableName**
- **Dep**(endent) or **Indep**(endent)
- **DatasetAssignment**,
- **FittingRange**

VariableName is the name of the variable. *Indep* or *Dep* specifies whether the variable is independent or dependent. *DatasetAssignment* is the name of the data set to which the variable is assigned. *FittingRange* is the data set range used in fitting.

If no data set assignment has been made, the associated section of the line displays question marks. This field updates during data set assignment.



The Available Datasets List Box

This list box displays the names of all the data sets in the project.

The Assign/Assign X Buttons

You must assign all the variables to data sets.

The way in which you assign variables to data sets differs depending on whether you are assigning a dependent or an independent variable.

To assign dependent variables to data sets:

1. Click on the dependent variable you want to assign in the Variables:Datasets list box. The row becomes highlighted. Additionally, the **Assign X** button becomes unavailable.
2. Click on the data set name you want the variable assigned to in the **Available Datasets** list box. The data set becomes highlighted.
3. Click **Assign** to assign the variable to the data set.

To assign independent variables to data sets:

1. Click on the independent variable you want to assign in the Variables:Datasets list box. The **Assign X** button becomes available.
2. Click on a data set name in the **Available Datasets** list box.
3. There are now two options. If you want the variable assigned to the data set which you highlighted in step b, click **Assign**. If you want the variable assigned to the 'x of' the data set which you highlighted in step b (rather than to the data set itself), click **Assign X**. The 'x of' a data set may have three different meanings: another data set; the data sets associated row numbers, or a defined starting value and a step increment.

The Fit Multiple Datasets Check Box

This check box allows you to fit multiple data sets to the *same* function. This check box, as well as the **Add Data** and **Remove Data** buttons, and the **Parameter Sharing** list box, are not available if your function contains more than one dependent variable.

To fit to multiple data sets:

1. Select the **Fit Multiple Datasets** check box. The **Parameter Sharing** list box and the **Add Data** and **Remove Data** buttons become available. The Parameter Sharing list box displays all the parameters. If you have not clicked on the Add Data button before, the Variables:Datasets list box still lists all the variables only once.
2. Click **Add Data**. This action allows you to fit your function to two data sets, which is reflected in the updated Variables:Datasets list box. There are now two entries for each variable, with each entry being indexed, such as, $y(1)$, $y(2)$, $x(1)$, $x(2)$. Each time you click **Add Data**, you enable one more data set to be fitted. You can remove them one-by-one by clicking on the Remove Data button.
3. Assign the variables to data sets. You *must* assign *all* the variables in the Variables:Datasets list box to data sets.
4. To share a parameter among all the data sets, double-click on one or more parameters in the **Parameter Sharing** list box. "Shared" is displayed next to the parameter name.

If a parameter is *not* tagged as "Shared", then there will be a separate "version" of the parameter for each data set.

If a parameter *is* tagged as "Shared", there will be only one, common, "version" for all the data sets. For example, suppose your function has *three* parameters: c , d , and e . You tag only the

parameters d and e as "Shared". Suppose that you want to fit *two* data sets. In this case you will have the total of four parameters to fit: one "version" of d and one "version" of e (since d and e are shared) and two (one for each data set) "versions" of c (since c is not shared).

Starting the Fitting

The Fitting Session Concept

Note: The NLSF always reports the *reduced* χ^2 value, not χ^2 . In some locations of the NLSF, reduced χ^2 is labeled " χ^2 ". In other locations, it is labeled " χ^2/DoF ". *In all cases* the actual value is reduced χ^2 .

The concept of a fitting session is important for your understanding of how Origin's nonlinear curve fitter works. At each iteration, the fitter computes the Variance-Covariance matrix using its value from the previous iteration.

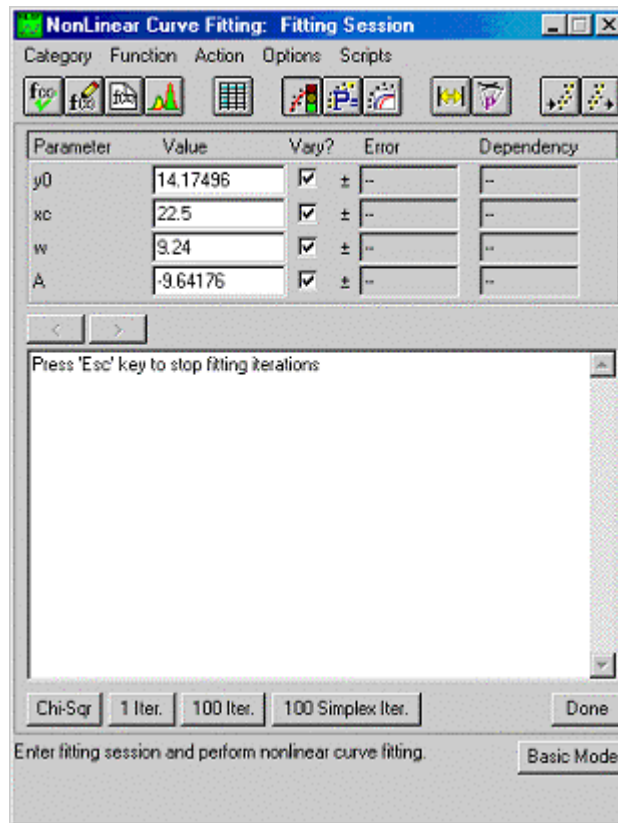
This matrix depends on:

- The fitting function.
- The number of parameters.
- The data set assignments.

If any of these properties are altered, the current Variance-Covariance matrix is unusable for the altered properties, which means that the fitting session has to end. When a fitting session ends, all the actions that you have selected or defined in the **After Fitting** dialog box are executed.

Additionally, when a fitting session starts, all the actions that you have selected or defined in the **Parameter Initialization** dialog box are executed. To make sure that you do not inadvertently end a fitting session, Origin's nonlinear fitter prompts you for the confirmation of your action by opening an Attention dialog box.

The Fitting Session Dialog Box



The **Parameter Value** Text Boxes

The NLSF provides automatic parameter initialization routines for all of the built-in functions. The parameter initialization routine for the selected fitting function can be reviewed in the **Parameter Initializations** dialog box of the NLSF (**Scripts:Parameter Initialization**). These routines use the selected dependent and independent data sets to determine appropriate initial parameter values for the selected fitting function.

The parameter initialization routine for a selected function is automatically run when you activate the Fitting Session dialog box. When activated, the **Value** text boxes display initial values and the graph displays a first guess fit curve in addition to your data. You can also manually run the parameter initialization routine by:

1. Activating the NLSF **Parameter Initializations** dialog box.
2. Clicking the **Check** button to compile the initialization routine.
3. Clicking the **Execute** button to run the initialization routine.

After clicking the Execute button, the **Init. Value** text boxes should display initial parameter values.

If you are fitting multiple data sets and you have some parameters which are not shared, the different versions of these parameters are denoted with $a_{\#}$, where a is the parameter.

You can edit the parameter values in the associated text boxes as desired. Every new iteration (or set of iterations) starts from these values.

The Vary Check Boxes

Each parameter contains a **Vary** check box. Select this check box to vary the parameter value during the iterative procedure.

Otherwise, the parameter remains fixed at its current value.

The Error List Boxes

If at least one iteration has been done, these list boxes contain the estimates of the standard errors.

The error is $\sigma_i = \sqrt{C_{ii}}$, where C_{ii} is the diagonal element of the variance-covariance matrix.

The variance-covariance matrix is defined as $C = (F' \otimes F)^{-1}$, where F is the Jacobian

$F_{ij} = \partial f(x_1, x_2, \dots, p_1, p_2, \dots) / \partial p_j$ (here f is the fitting function for the data set values of the independent variables $x_1 = x_1, x_2 = x_2, \dots$).

The Dependency List Boxes

These list boxes display the parameter dependency. If the equation is overparameterized, there will be mutual dependency between parameters.

$$1 - \frac{1}{C_{ii}C_{jj}}$$

The dependency for the i th parameter is defined as $1 - \frac{1}{C_{ii}C_{jj}}$. If this value is close to one, there is strong dependency.

The Chi-Sqr Button

Click **Chi-Sqr** to display the reduced χ^2 value for the current parameter values. The reduced χ^2 value is displayed in the view box at the bottom of the dialog box.

The 1 Iter(ation) Button

Click **1 Iter** to perform one Levenberg-Marquardt (LM) iteration. The new parameter values are displayed in the **Parameter Value** text box, together with the error and dependency values.

The n Itera(tions) Button

Click **n Iter** to cause the fitter to perform, at most, n LM iterations. Set n value from the **Max. Number of Iterations** drop-down list in the **Control Parameters** dialog box.

If the tolerance is reached or an error occurs before n iterations have been performed, less than n iterations will be performed. Sometimes the actual number of iterations performed may be zero. This happens if the parameter values cannot be improved any more. The number of iterations actually performed (which improved the fit by decreasing the reduced χ^2 value) is displayed in the view box at the bottom of the dialog box.

Stop the iterations at any time by pressing the ESC key.

The n Simplex Iter. Button

Click this button to perform n Simplex iterations. Normally, you will not need to do this because the Simplex method is much less robust and reliable than the LM method. However, if the LM method for a set of data behaves poorly, try the Simplex method.

The < and > Buttons

These buttons enable you to retrieve the values of parameters which the fitter has already gone through. For example, click the < button to display the parameter values that were current before the last iterations.

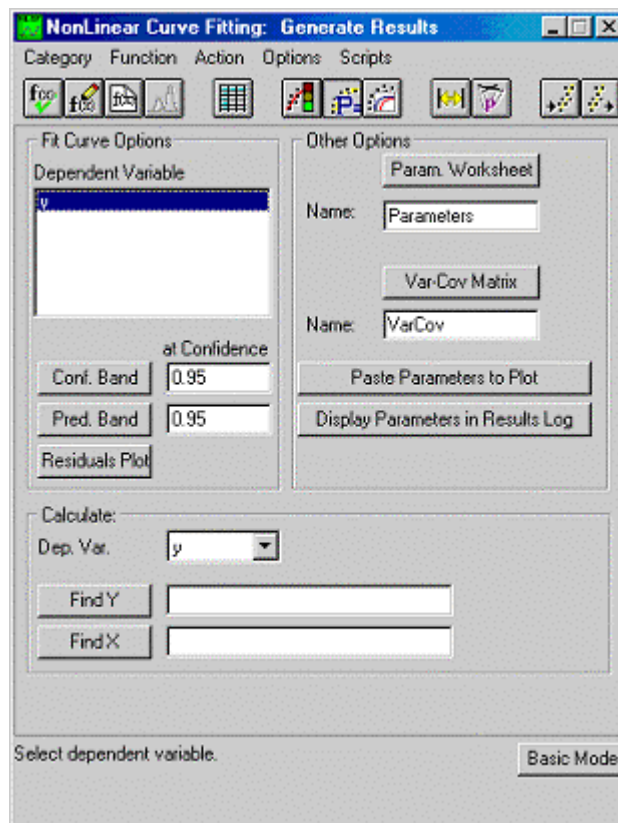
The View Box

This view box displays various quantities which change during a fitting session, including: the reduced χ^2 value, the parameter values, the error estimates, and the actual number of iterations performed (before the current iteration).

The Fitting Results

Select **Action:Results** to open the **Generate Results** dialog box. Edit this dialog box to create additional curves describing the results of your fitting, as well as to control the display of the fitting results. This dialog box is usually edited *after* you have found the best parameter values using the Fitting Session dialog box.

The Generate Results Dialog Box



The Fit Curve Options Group

This group enables you to create three supplemental curves for each dependent variable.

- **Confidence Band Curves**

Select a dependent variable from the Dependent Var. list box. Specify the desired confidence level in the At Confidence text box. Generate the confidence band curves for the selected dependent variable by clicking the Conf. Band button.

The confidence interval for the fitting function says how good your estimate of the value of the fitting function is at particular values of the independent variables $x_1 = x_{1i}, x_2 = x_{2i}, \dots$. You can claim with $100a\%$ confidence that the correct value for the fitting function lies within the confidence interval, where a is the desired level of confidence. This defined confidence interval for the fitting function f is computed as:

$$f(x_{1i}, x_{2i}, \dots; p_{1i}, p_{2i}, \dots) \pm t_d^{\alpha/2} \left[x^2 f' C f \right]^{1/2}$$

where $f' = \left[\partial / \partial \phi_1, \partial / \partial \phi_2, \dots, \partial / \partial \phi_r \right]$, $d = n^{\text{eff}} - p$ is the number of degrees of freedom, $t_d^{\alpha/2}$ is the bi-tail t -distribution value, $\alpha = 1 - a$, and C is the variance-covariance matrix.

- **Prediction Band Curves**

Select a dependent variable from the Dependent Var. list box. Specify the desired confidence level in the At Confidence text box. Generate the prediction band curves for the selected dependent variable by clicking the Pred. Band button.

The prediction interval for the desired confidence level a is the interval within which $100a\%$ of all the experimental points in a series of repeated measurements are expected to fall at particular values of the independent variables $x_1 = x_{1i}, x_2 = x_{2i}, \dots$. This defined prediction interval for the fitting function f is computed as:

$$f(x_{1i}, x_{2i}, \dots; p_{1i}, p_{2i}, \dots) \pm t_d^{\alpha/2} \left[x^2 (1 + f' C f) \right]^{1/2}$$

where $f' = \left[\partial / \partial \phi_1, \partial / \partial \phi_2, \dots, \partial / \partial \phi_r \right]$, $d = n^{\text{eff}} - p$ is the number of degrees of freedom, $t_d^{\alpha/2}$ is the bi-tail t -distribution value, $\alpha = 1 - a$, and C is the variance-covariance matrix.

- **The Residuals Plot Button**

Click this button to generate the residue plot for the selected dependent variable. Residue points represent the difference between the theoretical function and the actual data points.

The Param. Worksheet Button

Click this button to create a separate worksheet containing all the results of your fitting session (parameter values, reduced χ^2 value, errors, etc.). Type the desired worksheet name in the associated text box.

The Parameters worksheet lists the following quantities:

The first n rows of the worksheet list information on the n parameters that were involved in the fitting process. For each parameter, the quantities listed in successive columns are:

- a. Name: parameter name.
- b. Value: Parameter value obtained in the fitting process.
- c. Err: Error on the parameter value.
- d. Vary: Whether the parameter was allowed to vary (floating) or was fixed by the user (fixed).
- e. LLimit: Lower confidence limit on the parameter.
- f. ULimit: Upper confidence limit on the parameter.

LLimit and ULimit are calculated by searching for the values of each parameter p that give an $SSR(p)$ (minimized over the remaining parameters) greater than SSR by a factor $(1+F/(N-P))$.

$$SSR(p) = SSR * (1+F/(N-P))$$

Where $F = F_{table}(\text{Confidence}, 1, N-P)$ and SSR is the minimum SSR found during the fitting session.

- g. Depend: Dependency of the parameter (a value very close to 1 indicates strong dependency, and therefore, over parameterization).
- h. ConfIntv: Confidence interval. Calculated based on a linear approximation and is given by Standard Error * t , where t is the critical value of the t distribution for the given confidence level.

The n rows of parameter information are followed by:

- a. ChiSquare: reduced χ^2 value of fit.
- b. SSR: sum of squares of difference between data and fit values.
- c. Correlation: correlation coefficient (R).
- d. COD(R^2): Coefficient of Determination (R^2).
- e. MuFinal: final value of diagonal magnification of the curvature matrix.
- f. MuMin: smallest value of μ that was ever reaching during fitting.
- g. DerivStep: parameter change amount for calculating derivatives (Derivative Delta).
- h. ParaChange: the number of parameters that were allowed to vary during fitting.
- i. Tolerance: tolerance value to stop iterations.
- j. Confidence: value for deciding confidence bands.
- k. Iterations: the number of iterations performed in the last fitting operation.
- l. Range1: beginning index of data range used in fitting.
- m. Range2: ending index of data range used in fitting.
- n. Step: incremental step size used when only a subset of data points were used in the fitting process (Ex. Step =4 means every fourth data point was used).
- o. DataPoints: number of data points considered in the fitting process.

- p. DOF: no. of degrees of freedom = No. of data points considered - no. of floating parameters (parameters that were not fixed).
- q. Constr: the number of constraints that the user enters in the General Linear Constraints text box in the Parameter Constraints dialog box. The Enabled check box has to be selected for the constraints to be counted.
- r. ConstrEff: the number of effective constraints. If you type in constraints on a parameter and then fix the parameter value (clear the Vary? check box in the Fitting Session dialog box), those constraints will not be counted.

The Var-Cov Matrix Button

Click this button to create a separate window containing the variance-covariance matrix. Type the desired window name in the associated text box.

The Paste Parameters to Plot Button

Click this button to create a label on your graph, and paste the fitting results into the label.

The Display Parameters in Results Log Button

Click this button to copy the results to the Results Log.

The Calculate Group

Dep. Var. The Advanced Fitting Tool supports multiple dependent variables. When such is the case, you must choose a dependent variable from this drop-down list.

Find X/ Find Y. The Find X and Find Y buttons allow you to obtain a dependent variable value given an independent variable value, or obtain an independent variable value given a dependent variable value, respectively, from the fit you perform to the data. These buttons become active only after you perform a fit to the active data set.

Once the fit has been performed and the buttons are active, you can enter a numerical value in the top text box next to the **Find X** button (entering more than one value in the **Find X** or **Find Y** text boxes is *not supported*), and then press the **Find Y** button to obtain the corresponding X value. The exact fit equation that resulted from the fitting process is used to compute the Y value for the given X value. You can specify any X value inside or outside of the range of the data set or the fit line for computing the Y value.

To find an X value for a given Y value, you should enter the Y value in the bottom text box next to the Find Y button and then press Find X. When this action is performed, an iterative procedure is used to find the X value corresponding to the given Y value:

1. First a check is performed to see if the Y value you specified is inside the range of Y values described by the fit line. If not, no computation is done and you are informed that your Y value is out of range.

If the Y value passes this check, then the following steps are performed:

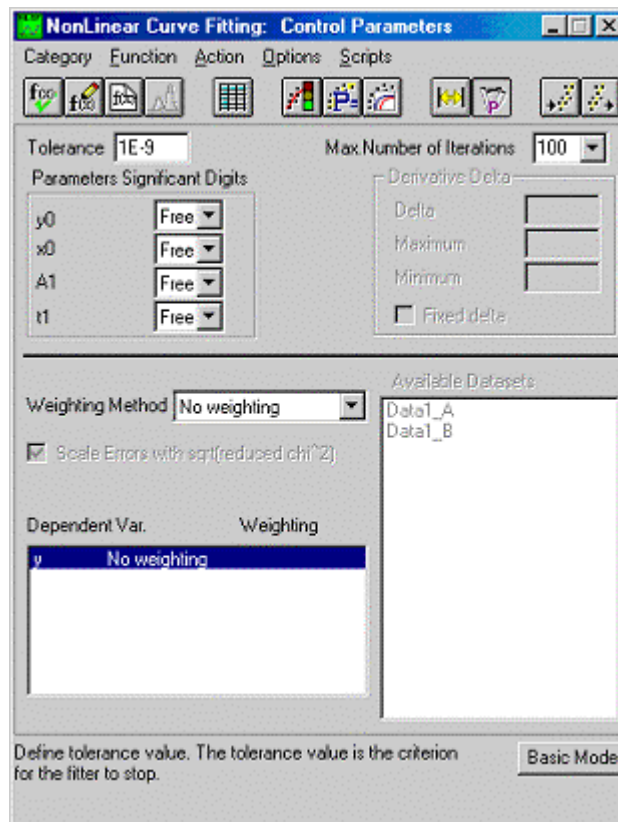
2. The fit line data set is scanned to find two points (X1,Y1) and (X2, Y2) such that the user-specified Y value lies in the interval [Y1, Y2]. In the case of a fit line that is not monotonic (ie. multiple X value exist for same Y value), the first interval that satisfies this criterion, starting from the lower end of the X axis, is selected.
3. The X value of the mid point of this interval is computed: $X_m = (X_1 + X_2) / 2$, and the corresponding y-value, Ym, is computed using the exact fit equation
4. The interval to the right or left of this midpoint is chosen such that the user-specified Y value now falls within the new interval.

5. This bisectional search is continued till the y-value of the mid point of the interval, Y_m , differs from the user-specified Y-value by less than 0.00001%, or until 200 iterations are performed, whichever comes first.
6. The X_m value corresponding to the final Y_m value is reported as the X value corresponding to the y-value you specified.

Controlling the Fitting Procedure

Select **Options:Control** to open the **Control Parameters** dialog box. Edit this dialog box to specify several quantitative properties of the fitting procedure. These properties directly affect the way the fitter performs iterations.

The Control Parameters Dialog Box



The Tolerance Text Box

Type a value for the tolerance in this text box.

When you click **n Iter** in the **Fit Session** dialog box, this causes the fitter to try to perform, at most, n LM iterations of reduced χ^2 . If the relative change of the value of reduced χ^2 between two successive iterations is less than the value in the **Tolerance** text box, less than n iterations are performed. If you want the fitter to perform still more iterations, click on either the **n Iter** or the **1 Iter** button in the **Fitting Session** dialog box. The n value is specified in the **Max. Number of Iterations** text box (see below).

The Max. Number of Iterations Drop-down List

Specify the value for the maximum number of iterations performed when the **n Iter** button is clicked on in the **Fitting Session** dialog box.

The Derivative Delta Group

This group determines how the fitter will compute the partial derivatives with respect to parameters for *user-defined functions* during the iterative procedure. The Derivative Delta group is unavailable for built-in functions as Origin's curve fitter uses analytical expressions. (Note: You can define a user-defined function with partial derivatives.)

For the user-defined functions, the derivative with respect to the parameter, P_1 , is computed as (for simplicity, written for a function which has one independent variable):

$$\text{derivative} = [f(x; p_1 + \text{Delta}, p_2, \dots) - f(x; p_1, p_2, \dots)] / \text{Delta}$$

where Delta is the increment.

If the **Fixed Delta** check box is selected, the value of Delta used in the computations is the value entered in **Delta** text box and is the same for all the parameters. The **Maximum** and **Minimum** text boxes are then disabled.

If the **Fixed Delta** check box is *cleared* (unchecked), then the actual value of Delta for a particular parameter is equal to the current value of the parameter times the value specified in the **Delta** text box. In this case, use the **Maximum** and **Minimum** text boxes to specify the limiting values of the actual Delta in case a parameter value becomes too large or too small. \

It is recommended (at least when you start fitting your new function,) *not* to select the **Fixed Delta** check box.

The Parameters Significant Digits Group

Select values for the display of significant digits for each parameter from the associated drop-down list. Select **Free** from the drop-down list to use the current Origin setting.

The Weighting Method Drop-Down List

The bottom part of the Control Parameters dialog box enables you to select how different data set points are to be weighted when computing reduced χ^2 during the iterative procedure. Select the desired weighting method from the **Weighting Method** drop-down list. The choices are: **No weighting**, **Instrumental**, **Statistical**, **Arbitrary** data set, and **Direct Weighting**.

If you select the **Arbitrary** data set method, specify the data set which contains the weighting values for each dependent variable from the **Available Datasets** list box.

The Scale Errors with Sqrt(reduced χ^2) Check Box

This check box only affects the error on the parameters reported from the fitting process, and does not affect the fitting process or the data in any way.

Leave the check box selected when there are no associated error bars with the data (which is the default - and only - option). In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii})$.

Leave the check box cleared when the data has associated error bars and a weighting method has been chosen by you. This is the default, and recommended setting for this check box. In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii})$.

When the data has associated error bars and a weighting method has been chosen by you, you have the option to select the check box, thereby multiplying the reported error on the fit parameters by

the square root of the reduced chi-squared. In this case, the error on the fit parameters is calculated as $\text{SQRT}(\text{cov}_{ii} * (\text{Chi}^2/\text{DOF}))$.

The **Dependent Var.** List Box

If you selected the **Arbitrary** data set method from the **Weighting Method** drop-down list, highlight a dependent variable in this list box. Click on the desired data set name in the *Available Datasets* list box.

The **Available Datasets** List Box

Click on the data set name in this list box after selecting the dependent variable in the **Dependent Var.** list box (for **Arbitrary** data set weighting method only).

Setting the Parameter Constraints

Select **Options:Constraints** to open the **Parameter Constraints** dialog box. Impose linear constraints on the parameter values in this dialog box. If the constraints are selected, the fitter chooses only those combinations of parameter values which satisfy the constraints during the iterative procedure.

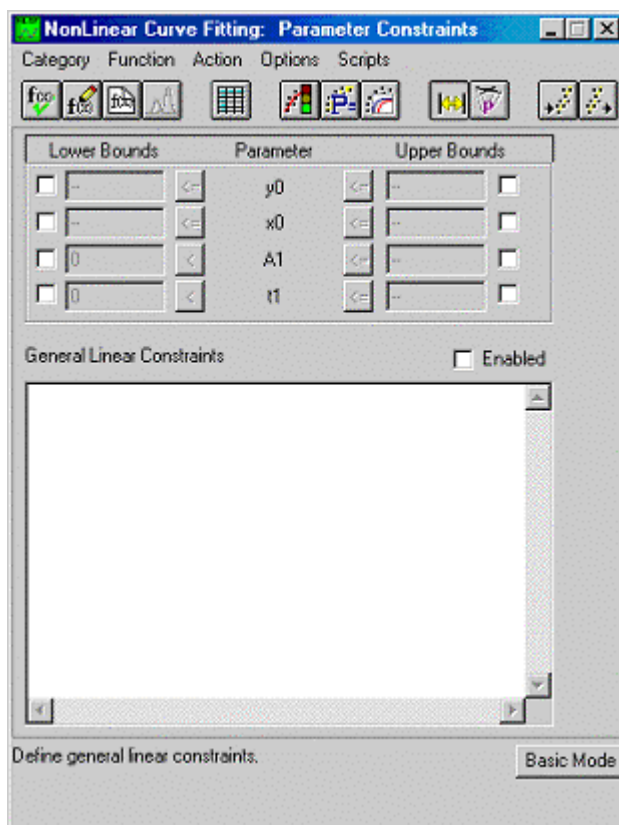
Use the constraints if the fitting procedure is unstable causing the parameters to wander into wrong parameter regions (For example).

In the exponential growth model

$$y = A \exp\left[(x - x_0) / \tau\right]$$

the values of the parameter τ close to zero may cause instabilities. A constraint such as $\tau \geq 0.1$ may remedy the problem.

The Parameter Constraints Dialog Box



The Lower and Upper Bounds Group

Simple constraints such as lower and upper bounds on the parameters are set in this group. The parameter names are listed in the middle of each row. The **Lower Bounds** and **Upper Bounds** text boxes contain the lower and the upper bounds.

If you have not set a particular bound, the corresponding text box is empty. Edit the bounds by selecting the associated check boxes. Click the \leq buttons to toggle between \leq (less than or equal to) and $<$ (less than). Type the desired value in the text box. Disable a bound by clearing the associated check box.

The General Linear Constraints Edit Box

Impose general linear constraints in the associated text box using the following format (assuming **a**, **b**, **c**, and **d** are parameters):

$a > b$;

$a + 2 * b \geq c * 2 - d$;

$a < b < c$;

$a / 3 < 9$

If there is more than one constraint, separate constraints by a semicolon. To change lines, press CTRL+ENTER.

Because they are nonlinear, the following examples are invalid as constraints :

$a^2 > c$;

$a * b > 3$;

$1/b > c + 2$;

$\sin(a) < c$;

Five relational operators are supported: =, <, <=, >, and >=. The curve fitter treats < and <= the same. Likewise > and >= are treated the same (this is not true for simple constraints, see above).

You can place multiple operators in a single sentence, such as:

$4 < a < b < 6$

which is equivalent to:

$4 < a; a < b; b < 6$

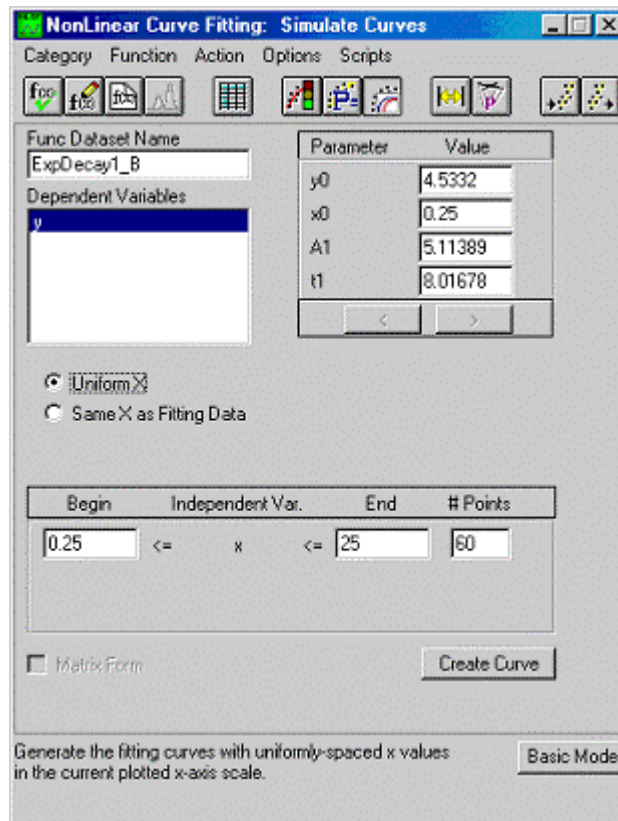
Coefficients need not be numeric constants. However, they must evaluate to valid numbers. For example, if the function has two parameters, **P1** and **P2**, you can use a linear constraint such as $P1 + qw * P2$ assuming that you have previously given **qw** a numeric value.

Temporarily disable constraints by clearing the **Enabled** check box. Constraints take effect only if the **Enabled** check box is selected.

Simulation of Data

Select **Action:Simulate** to open the **Simulate Curves** dialog box. Features provided in this dialog box are useful when you are uncertain about the initial values of parameters for fitting. You can plot the theoretical function for any parameter values in order to compare the curve with the data. This enables you to get an understanding of which parameter values produce curves that “look like the data”. This is important because reasonably good starting parameter values are in most cases a precondition for fitting success.

The Simulate Curves Dialog Box



The Func Dataset Name Text Box

This text box displays the name of the data set which will contain the theoretical data points to be generated.

The Dependent Variables List Box

All the dependent variables are displayed in this list box. Click to select a variable to be plotted.

The Parameter Group

The names of all the parameters are displayed in the list box. Set the parameter values used for plotting the theoretical curve in the associated text box. Click the < and > buttons to browse through the sets of parameter values for which you have already created curves. If you select **Action:Fit**, the last set of parameter values selected in this dialog box are carried over to the **Fit Session** dialog box, which enables you to start fitting from these values.

The Begin/End Group

Determine how to plot the theoretical curves for the simulation in the **Begin/End** group. All independent variables are listed in this view box. Set the lower and the upper limit of the independent variable values by editing the associated **Begin** and the **End** text boxes. Select the number of theoretical points in the associated **# Points** text box. If there is more than one independent variable, then the **# Points** text boxes must contain the same number for each independent variable. Origin's fitter generates theoretical curves as follows:

1. One data set (or column in a worksheet) is created for each independent variable. The number of rows is the same for all of the data sets (columns).

2. The fitter takes the independent variable values from a row, computes the values of the dependent variable(s), and displays them. The process is repeated for each row.

The Create Curve Button

Click **Create Curve** to generate the curve.

The Matrix Form Check Box

This check box applies only if there is more than one independent variable. If the check box is selected, the theoretical curve will be simulated on a grid. Note that this way of simulating curves requires much more computer memory (for example, if you have specified 60 points for each of the *three* independent variables, the use of **Matrix Form** will create 60x60x60 values, rather than only 60).

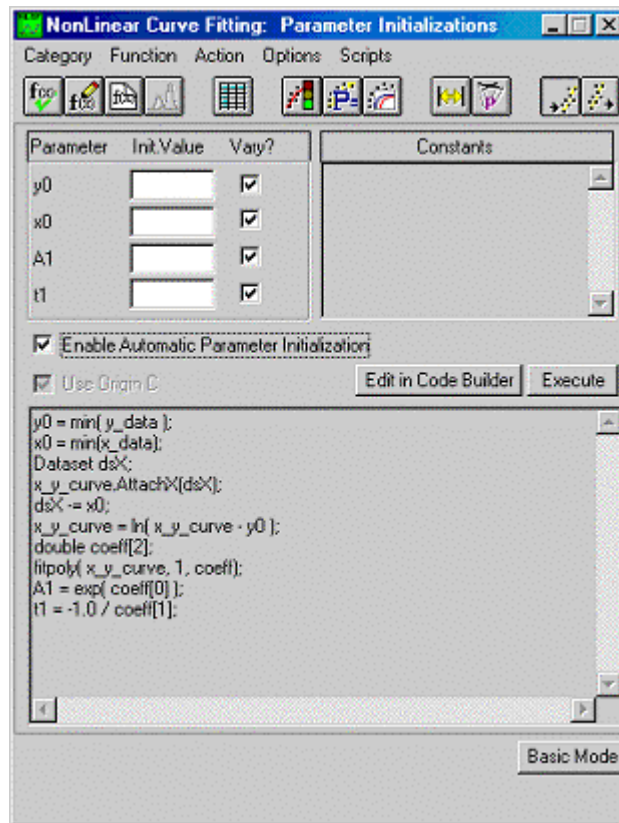
Running Scripts at Specified Triggers

Parameter Initialization

Select **Scripts:Parameter Initialization** to open the **Parameter Initializations** dialog box.

Upgrade Note: If the version you are upgrading includes a user-defined fitting function with LabTalk script defined in the pre-7 Parameter Initializations dialog box of the NLSF, then this script will be accessible from the **Before Fitting** dialog box (**Scripts:Before Fit**) in the post-version 7 NLSF. Any Origin C code or LabTalk script that you enter on the **Parameter Initializations** dialog box will be executed *after* the **Before Fitting** script when you activate the **Fitting Session** dialog box.

The Parameter Initializations Dialog Box



The Parameter Group

The NLSF provides automatic parameter initialization routines for all of the built-in functions. The parameter initialization routine for the selected fitting function can be reviewed in this dialog box. These routines use the selected dependent and independent data sets to determine appropriate initial parameter values for the selected fitting function.

The parameter initialization routine for a selected function is automatically run when you activate the **Fitting Session** dialog box. When activated, the **Value** text boxes in the Fitting Session dialog box display initial values and the graph displays a first guess fit curve in addition to your data.

You can also manually run the parameter initialization routine from this dialog box by:

1. Clicking the **Check** button to compile the initialization routine.
2. Clicking the **Execute** button to run the initialization routine. After clicking the Execute button, the **Init. Value** text boxes should display initial parameter values.

You can also edit these parameter values as needed.

The Constants Text Box

If your function contains constants other than the parameter names and the independent or dependent variables, and the values of those constants are not specified in the function definition script or outside the fitter (for example, in the Script window), define these constants in the **Constants** text box. When you define the constants in this field, you will never have to set them as fixed, because they are automatically set.

The proper procedure to follow when using the Constants text box is to first define your function with the constant parameter names in it using the fitter's **Define New Function** dialog box. When

you type your parameter names in the Define New Function dialog box, *do not include* the constant parameter names. Instead, define the constant parameters in the **Constants** text box (in the **Parameter Initializations** dialog box). Enter the constant parameters in this field as follows: c0=2; <Enter> c1=3; <Enter> and so on. In other words, each constant term and its associated value should be separated by a semicolon (;).

When the fitting process is performed the constants terms will automatically be figured into the calculation, but will not show up in the parameter list for initialization since they are already initialized and set as fixed by entering them into the Constants field.


Note: The following numeric system variables should not be used as constant names: X1...Xn, Y1...Yn, Z1...Zn, and the letter i. There are also LabTalk system variables which should be avoided. For more information on these system variables, see the LabTalk Help file. Furthermore, the letters T, J, and E should be avoided. As a result of these limitations, it is suggested that constant names contain more than one character.

The Initialization Scripts Text Box

For user-defined fitting functions, you can write your own initialization routines in this text box. If you enter Origin C code (instead of LabTalk script), you must select the **Compile** check box so that the routine gets compiled when you activate the **Fitting Session** dialog box. You can also click the **Check** button to immediately compile the routine to check for syntax errors. The **Execute** button runs the parameter initialization routine and initializes the fit parameters. Additionally, the routine is automatically run when you activate the **Fitting Session** dialog box.

For help in writing the Origin C parameter initialization routine for your user-defined function, review the initialization routines provided with the built-in functions. You can review them in the NLSF or you can review the [Parameters Initialization] section of the built-in function's .FDF file.

The parameter initialization routines for the built-in functions call Origin C functions that are defined in the internal.c source file which is located in your Origin \ORIGINC\SYSTEM subfolder. To review these functions, open internal.c in Code Builder (click the Code Builder

button  on Origin's Standard toolbar and then click the Open button). Notice that some functions such as sort, smooth, and xatymn take a Curve as an argument. Other functions such as min take a Dataset as an argument.

To pass a Curve to a function, use the notation *independentVar_dependentVar_curve*. For example, if your independent variable is named position and your dependent variable is named amplitude, then pass a Curve to the function using the argument *position_amplitude_curve*.

To pass a Dataset to a function, use the notation *independentVar_data* or *dependentVar_data*. For example, if your dependent variable is named amplitude, then pass a Dataset (in this case, the dependent variable) to the function using the argument *amplitude_data*.

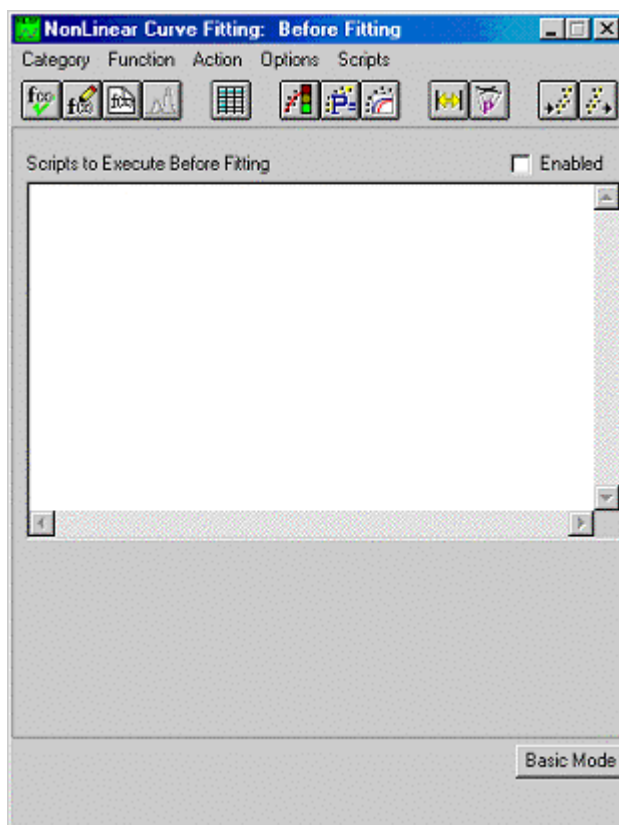
For more information, see the Programming Help file (**Help:Programming**).

Note for built-in and user-defined fitting functions that include parameter initialization routines: If a fit drifts off during the minimization process, re-select the Parameter Initializations tab and click the Execute button. This action re-runs the parameter initialization routines and resets the fit.

Before Fitting

Select **Scripts:Before Fit** to open the **Before Fitting** dialog box. Edit this dialog box to define what you want Origin's nonlinear curve fitter to do when *starting* a fitting session.

The Before Fitting Dialog Box



Type a LabTalk script in the **Scripts to Execute Before Fitting** text box for execution when entering a fitting session. The script in this text box will execute *before* any scripts in the **Parameter Initializations** dialog box. However, you must select the **Enabled** check box for the script to execute.

Note: You cannot enter Origin C routines in this dialog box - only LabTalk is allowed. However, you can compile an Origin C function in Code Builder and then call that function using LabTalk. For more information on Origin C, see the Programming Help file (**Help:Programming**).

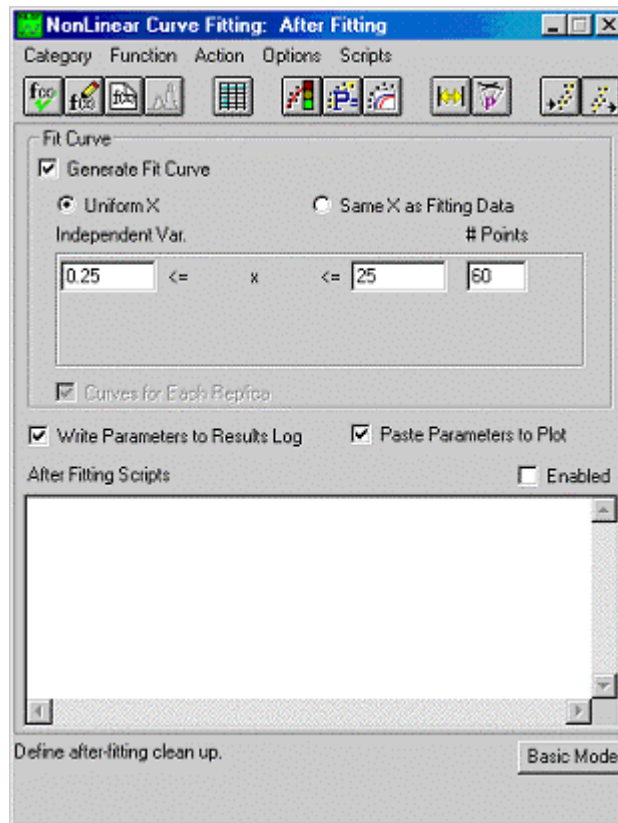
Upgrade Note: If the version you are upgrading includes a user-defined fitting function with LabTalk script defined in the pre-7 **Parameter Initializations** dialog box of the NLSF, then this script will be accessible from the **Before Fitting** dialog box (**Scripts:Before Fit**) in the post-version 7 NLSF. Any Origin C code or LabTalk script that you enter on the Parameter Initializations dialog box will be executed *after* the Before Fitting script when you activate the Fitting Session dialog box.

After Fitting

Select **Scripts:After Fit** to open the **After Fitting** dialog box. Edit this dialog box to define what you want Origin's nonlinear curve fitter to do when *ending* a fitting session.

Note: You cannot enter Origin C routines in this dialog box - only LabTalk is allowed. However, you can compile an Origin C function in Code Builder and then call that function using LabTalk. For more information on Origin C, see the Programming Help file (**Help:Programming**).

The After Fitting Dialog Box



The Fit Curve Group

Select the **Generate Fit Curve** check box to create a new data set which contains the theoretical curve points and display the curve on the graph. Select the X data set source from the associated radio buttons.

Uniform X means that the fitter chooses equidistant points.

Same X as Fitting Data means that the curve is created for the points contained in the original data.

Select the **Curves for Each Replica** check box to create a separate curve for each replica. The number of replicas is set in the **Replicas** dialog box.

Note: If you clear the **Generate Fit Curve** check box and later end the fitting session, the fitting curve that is displayed during the iterative process will be erased.

The Write Parameters to Results Log Check Box

Select this check box to send the fitting results to the Results Log when ending a fitting session.

The Paste Parameters to Plot Check Box

Select this check box to create a label on your graph and paste the fitting results onto it when ending a fitting session.

The After Fitting Scripts Text Box

Type a LabTalk script in this text box for execution when ending a fitting session. For example, if you want the fitting results displayed or stored in a particular manner, write a script which performs the task and enter it in this text box.

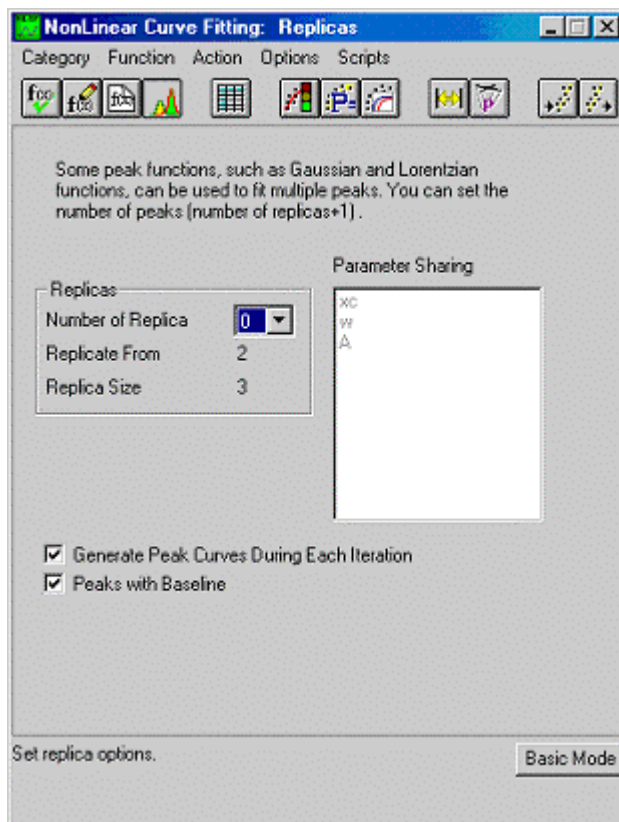
The script entered in the **Scripts After Fitting** text box is executed when ending a fitting session only if the **Enabled** check box is selected.

Fitting Multiple Peaks with Replicas of the Function

Select **Options:Replicas** to open the **Replicas** dialog box. Edit this dialog box to fit your data to some of the built-in peak functions by replicating the function into several “copies”, each of which may have different parameters. Use this feature if you believe that your data contain multiple peaks of the same sort (say, Lorentzian) but different centers and/or widths. If the function you have selected does not support replications, this dialog box is disabled.

Edit this dialog box to fit your data to some of the built-in peak functions by replicating the function into several “copies”, each of which may have different parameters.

The Replicas Dialog Box



The Replicas Group

Select the number of replicas (“copies”) of the function that you want to use in fitting from the **Number of Replicas** drop-down list. You must set the number to $n - 1$, where n is the number of peaks you believe are present in your data.

The **Replicate From** value shows which parameters are used for fitting multiple peaks for the particular function. For example, in the case of a Gaussian function the parameters are ordered as: xc , w , and A in the function definition file. If the value of **Replicate From** is 2, that means that the parameters, beginning with the second one (w), will be used in replicas, whereas there will be only one value of the first parameter (xc).

The **Replica Size** is the number of parameters used in replicas.

The Parameter Sharing List Box

Specify if you want some of the parameters in the replicate unit to have the same value for all the peaks by tagging those parameters as shared. Tag a parameter as shared by double-clicking on its name in the **Parameter Sharing** list box. The meaning of parameter sharing (here) is the analogous to the same feature when fitting multiple data sets.

The Generate Peak Curves During Each Iteration Check Box

Select this check box to display the peak curves for each replica after every iteration.

The Peaks with Baseline Check Box

Select this check box if you want each peak curve to be plotted from the common vertical offset.

Initializing the Fitter

Select **Action:Initialize** to initialize the fitter. This action should be performed after you are done fitting the current data set and before starting a new fitting process in another data set. The initialization resets all settings under the various menu options to the default values.

You need *not* perform this operation if you are fitting subsequent data sets with the same fitting function, and would like to retain your settings under various menu options.

Using the Fitter with the Network Version of Origin

An Origin client can modify or create a fitting function. If the created function has the same name as a server fitting function, the client function is used for fitting.

To define a new fitting function on an Origin server so that clients can use it, perform the following:

1. Run the server and create the new fitting function.
2. On the server, rename the created *.FDF file (in the \FITFUNC folder) from *User#.FDF* to *NewName.FDF* where *NewName* is descriptive of the function.
3. In the server's NLSF.INI file, change the default FDF file name for the newly created fitting function from *User#* to *NewName*, where *NewName* is the same descriptive file name.
4. Copy this line you just modified:

New Function Name = NewName

from the server's NLSF.INI file to the client's NLSF.INI file, under the same [FunctionGroup] section.

The client can now use this server-defined fitting function.

Fitting Strategies

Do I need NLSF?

Before even starting Origin's nonlinear least squares fitter (NLSF), you must determine if you actually need it. If you want to fit a function, such as:

$$y = p_1 \sin(x) + p_2 x$$

you may be tempted to use NLSF since the function is obviously nonlinear. However, Origin's NLSF is primarily intended for use with functions which depend *nonlinearly* on at least one of its *parameters*. Since the above function is linear in the parameters, you may be better off trying (multiple) linear regression, which is also supplied with Origin.

Using the Built-in Functions

Before deciding to define your own function, make sure that the function you need is not already among the built-in functions. This is very important because of the way the Levenberg-Marquardt χ^2 minimization is implemented in Origin's NLSF. For user-defined functions, in each iterative step the NLSF computes partial derivatives of the fitting function(s) with respect to parameters in all the data set points. For built-in functions, Origin's NLSF uses built-in analytical derivatives for the computation of the derivatives, which is more reliable than straightforward numerical computation of the same derivatives. (Note: You can define a user-defined function with partial derivatives.)

Parameter Initialization

An indispensable part of any fitting procedure is a good choice of initial parameter values. The NLSF provides automatic parameter initialization routines for all of the built-in functions. The parameter initialization routine for the selected fitting function can be reviewed in the Parameter Initializations dialog box of the NLSF (**Scripts:Parameter Initialization**). These routines use the selected dependent and independent data sets to determine appropriate initial parameter values for the selected fitting function.

The parameter initialization routine for a selected function is automatically run when you activate the Fitting Session dialog box of the NLSF (**Action:Fit**). When this dialog box is activated, the Value text boxes display initial values and the graph displays a first guess fit curve in addition to your data.

You can also manually run the parameter initialization routine by:

1. Activating the NLSF **Parameter Initializations** dialog box.
2. Clicking the **Check** button to compile the initialization routine.
3. Clicking the **Execute** button to run the initialization routine. After clicking the Execute button, the **Init. Value** text boxes should display initial parameter values.

You can also check and improve initial parameter values using the **Simulate Curves** dialog box of the NLSF (**Action:Simulate**). Use this dialog box to plot your theoretical function for any choice of parameters. Thus, you can easily compare your data with the theoretical function for any choice of parameter values. When you find a set of parameter values that generates the curve which closely resembles the data, start the iterative procedure from those values.

When the Fitting Procedure Does Not Converge

Using Constraints

When trying to reach the reduced χ^2 minimum, the Levenberg-Marquardt method carefully chooses the path in the parameter space which should lead to the minimum. However, there are situations when good initial parameter values are hard to find and a small departure can cause the fitter to wander away from the minimum without being able to come back. To prevent that, you may impose linear constraints on the parameters.

For example, if you believe that the reduced χ^2 minimum for a particular case of Gaussian fit corresponds to the Gaussian width being greater than 0.1, you can prevent the fitter from trying too small values of the width w by imposing a constraint $w > 0.1$. Since too small values of the width can easily cause an arithmetic underflow, you may improve the stability of the iterative procedure.

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Analysis: Statistics

Descriptive Statistics

Statistics on Columns

To produce descriptive statistics on worksheet data:

1. Highlight the desired column(s) or a range of cells
2. Select **Statistics:Descriptive Statistics:Statistics on Columns**.

This menu command opens a new worksheet that displays the mean, standard deviation, standard error of the mean, minimum, maximum, range, sum, and number of points for each of the highlighted columns (or ranges) in the active worksheet. The standard deviation and standard error of the mean columns are automatically set as error bars to direct plotting.

The new worksheet contains a **Recalculate** button to recalculate the statistics data if column values change. By default, the **Advanced Statistics** check box is selected (advanced statistics include the median, 25th and 75th percentiles (lower and upper quartiles), user-defined percentile (specified in the Percentile text box), Inter Quartile Range, variance, 95% confidence limits on the mean, and Kurtosis). Clear **Advanced Statistics** and click **Recalculate** to obtain a reduced set of parameters.

The standard deviation (SD) is calculated as follows:

$$SD = \sqrt{Var}$$

where

$$Var = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2, \text{ } n \text{ is the sample size, and } \bar{X} \text{ is the mean.}$$

The standard error of the mean (SEM) is calculated as follows:

$$SEM = \frac{SD}{\sqrt{n}}$$

See the note on The **Percentile with Averaging** Text Box on the Graph tab of the Options dialog box (page .

Note: Columns that are set to **Disregard** from the **Plot Designation** drop-down list of the **Worksheet Column Format** dialog box as well as columns that are set to **Text** from the **Display** drop-down list of this dialog box *are not used* in the calculation)

Statistics on Rows

To produce descriptive statistics on rows of data:

1. Highlight the desired cells (including columns of data).
2. Select **Statistics:Descriptive Statistics:Statistics on Rows**.

This menu command creates a new worksheet displaying the row number, mean, standard deviation, standard error of the mean, minimum, maximum, range, and number of points for the selected data.

For methods of standard deviation and standard error calculation, see *Statistics on Columns* on page 567.

Note: Columns that are set to **Disregard** from the **Plot Designation** drop-down list of the **Worksheet Column Format** dialog box as well as columns that are set to **Text** from the **Display** drop-down list of this dialog box are not used in the calculation.

Frequency Count

To determine a frequency count for a column or range of values, select **Statistics:Descriptive Statistics:Frequency Count**. This menu command opens the **Count** dialog box in which you specify the **From Minimum**, **To Maximum**, and **Step Size** values. Origin uses this input to create a set of bins, beginning at the minimum value and creating the necessary number of bins based on the step size. Origin then searches each bin, and records the number of times a value is encountered that falls within each bin. If a value falls *on the upper edge of the bin, it is included in the next higher bin*.

Origin then creates a worksheet with four columns. The first column displays the mid-point value in each bin (**BinCtr**), the second column displays the number of “hits” observed for each bin (**Count**), the third column displays the end point of each bin (**BinEnd**), and the fourth column displays the cumulative count (**Sum**).

	BinCtr[X]	Count[Y]	BinEnd	Sum[Y]
1	4.5	21	5	21
2	5.5	45	6	66
3	6.5	9	7	75
4	7.5			
5	8.5			
6	9.5			
7	10.5			
8	11.5			
9	12.5			
10	13.5			

Statistics on Data1_B:		
Mean	SD	Size
6.45244	2.24648	100
Median		
5.44767		

The **Results Log** displays the **Mean**, standard deviation (**SD**), **Size**, and **Median** for the selected data. The data are sorted to calculate the median value.

Normality Test (Shapiro-Wilk)

The **Shapiro-Wilk Normality Test** is used to determine whether or not a random sample of values (X_i for $i = 1$ to n) follows a normal distribution. The Normality Test is useful because other statistical tests (such as the t-Test) assume that data is sampled from a normally distributed population. A **W** statistic and a **P** value are computed, from which a statistical decision can be made by comparison with a level of significance.

The **W** statistic is defined as:

$$W = \frac{\left(\sum_{i=1}^n A_i X_i \right)^2}{\sum_{i=1}^n (X_i - \bar{X})^2}$$

where

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

and A_i is a weighting factor.

The **W** value reported by Origin is computed using the NAG function **nag_shapiro_wilk_test (g01ddc)** that implements the Applied Statistics Algorithm AS 181 described in Royston (1982). The function supports sample sizes of $3 \leq n \leq 2000$. See the NAG documentation for more detailed information.

Performing the Shapiro-Wilk Normality Test

To run the Shapiro-Wilk Normality Test:

1. Highlight one or more columns of non-text data in a worksheet.
2. Select **Statistics:Descriptive Statistics:Normality Test (Shapiro-Wilk)**.

The test is performed and the data set name, sample size, **W** statistic, **P** value, and decision rule (based on a default significance level of 0.05) is output for each selected data set.

To specify a significance level other than 0.05:

1. Open the Script window (**Window:Script Window**).
2. Assign a value between 0 and 100 to the LabTalk variable ONormTestSL prior to executing the Normality Test menu command.

For example, entering:

ONormTestSL=10 (Press ENTER)

will set the Normality Test significance level to 0.1.

Hypothesis Testing

One Sample t-Tests

A one sample t-Test can be employed to test whether or not the true mean of a population, μ , is equal to or different than a specified test mean, μ_0 . The one sample t-Test is performed on a sample data set that is randomly drawn from a population of scores that is assumed to follow a normal distribution.

Theory: One Sample t-Test:

The one sample t-Test can either be a one- or two-tailed test depending on the nature of the variable under study and the objectives of the experimenter. The experimenter develops a null hypothesis (H_0) that is the logical counterpart, mutually exclusive and exhaustive, to an alternative hypothesis (H_1) which the experimenter is attempting to evaluate. Depending on the outcome of the test, the null hypothesis is either rejected or retained. Rejection of the null hypothesis logically

leads to acceptance of the alternative hypothesis and retention of the null hypothesis leads to an inability to accept the alternative hypothesis. Two-tailed hypotheses take the form:

$$H_0: \mu = \mu_0 \quad \text{and} \quad H_1: \mu \neq \mu_0$$

while one-tailed hypotheses take the form:

$$H_0: \mu \leq \mu_0 \quad \text{and} \quad H_1: \mu > \mu_0 \quad \text{or} \quad H_0: \mu \geq \mu_0 \quad \text{and} \quad H_1: \mu < \mu_0$$

depending on the direction of the test.

The test statistic t is used to evaluate the null hypothesis which then allows the indirect

$$t = \frac{(\bar{X} - \mu_0)}{SD/\sqrt{n}}$$

evaluation of the alternative hypothesis. The computed test statistic, , has a

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i \quad \text{and}$$

Student's t-distribution with $\nu = n - 1$ degrees of freedom, where

$$SD = + \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n - 1}}$$

. We reject the null hypothesis H_0 (and thereby accept the alternative hypothesis H_1) when t is extreme enough to cause the observed significance to be less than some pre-specified significance level. We retain the null hypothesis (and thereby fail to accept the alternative hypothesis) when the observed significance is greater than the pre-specified significance level. The observed significance (or P value) is the probability of obtaining a test statistic as extreme or more extreme than t due to chance factors alone. The pre-specified significance level is called alpha (α) or just significance level.

In the context of a one sample t-Test, a confidence interval consists of a lower limit and an upper limit that, with some specified degree of confidence, contains the true mean of the population. The degree of confidence (or probability) that a given confidence interval contains the true mean of a population is called the confidence level. The lower and upper limits of a confidence interval

are $\bar{X} \pm \frac{t_{1-\alpha/2}(\nu)SD}{\sqrt{n}}$ where \bar{X} and SD are defined as above. The factor $t_{1-\alpha/2}(\nu)$ is a critical value of t from the Student's t distribution indexed at the $1-\alpha/2$ level and by $\nu = n - 1$ degrees of freedom. Here alpha (α) is specified by the confidence level where $\alpha = 1 - (\text{confidence level}/100)$.

The power of a one sample t-Test is a measurement of its sensitivity. In terms of the null and alternative hypotheses, power is the probability that the test statistic t will be extreme enough to allow the rejection of the null hypothesis when it should in fact be rejected (i.e. given the null hypothesis is not true). For each of the three different null hypotheses, power is mathematically defined below.

$$\text{For } H_0: \mu = \mu_0, \quad \text{Power} = 1 - P[T \leq t_{1-\alpha/2}(\nu) - t] + P[T \leq t_{\alpha/2}(\nu) - t]$$

$$\text{For } H_0: \mu \leq \mu_0, \quad \text{Power} = 1 - P[T \leq t_{1-\alpha}(\nu) - t]$$

$$\text{For } H_0: \mu \geq \mu_0, \quad \text{Power} = P[T \leq t_{\alpha}(\nu) - t]$$

where T is a random variable having a t distribution with ν degrees of freedom, the computation of the test statistic t is given above, the terms $t_{1-\alpha/2}(\nu)$, $t_{\alpha/2}(\nu)$, $t_{1-\alpha}(\nu)$, and

$t_{\alpha/2}(\nu)$ are critical values of t from the Student's t distribution indexed at the $1-\alpha/2$, $\alpha/2$, $1-\alpha$, and α levels and by $\nu = n-1$ degrees of freedom. The computation for hypothetical power is the same as for actual power except that the test statistic t , the critical values of t , and ν are recomputed using hypothetical sample sizes instead of the actual sample size.

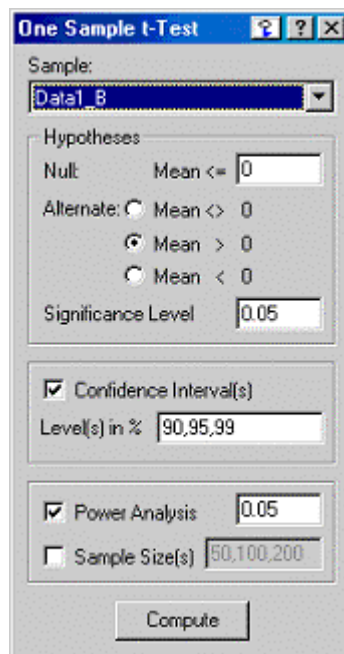
To perform a one sample t-Test:

1. Highlight the desired worksheet column.
2. Select **Statistics:Hypothesis Testing:One Sample t-Test**.

The menu command opens the **One Sample t-Test** dialog box in which you specify the **Sample** data set as well as all other test parameters described below. After clicking the **Compute** button, the test results are output to the **Results Log**. The results include the sample data set's name, mean (\bar{X}), standard deviation (SD), standard error (SE), and sample size (n). The test statistic (t), degrees of freedom (DF or ν), observed significance (P value), the null (H_0) and alternative (H_1) hypotheses, and the decision rule of the test are output as well.

If the **Confidence Interval(s)** and **Power Analysis** check boxes are selected, then all specified confidence intervals and the actual power of the experiment are output. Checking the **Sample Size(s)** check box causes a hypothetical power for each specified sample size to also be output.

One Sample t-Test Controls



The Sample Combination Box

Select the sample data set on which to perform a one sample t-Test. The sample data is assumed to have been drawn from a population that follows a normal distribution.

The Hypotheses Group

Enter the test mean, μ_0 , in the **Null Hypothesis** edit box just to the right of **Mean =**. The value of the test mean displayed in each of the three **Alternate Hypotheses** updates accordingly.

Select the appropriate radio button for Alternate Hypothesis indicating whether a two-tailed or one-tailed t-Test is to be performed. The direction of the one-tailed t-Test is also specified by the radio button selection. The (in)equality of the Null Hypothesis updates accordingly.

Enter a decimal value greater than 0 and less than 1 for alpha (α) in the Significance Level edit box. The Power Analysis edit box in the Power Analysis group is initialized to the same value of alpha (α) and, if unique, a complementary $([1-\alpha]*100)$ confidence level is added to the Level(s) in % edit box in the Confidence Interval(s) group.

The Confidence Interval(s) Group

Select or clear the **Confidence Interval(s)** check box to determine whether or not confidence intervals are computed.

The **Level(s) in %** edit box is enabled when the Confidence Interval(s) check box is selected.

Enter a comma separated list of confidence levels greater than 0 and less than 100 in the Level(s) in % edit box.

The Power Analysis Group

Select or clear the **Power Analysis** check box to determine whether or not the "actual" power of the t-Test is computed. The **Power Analysis** edit box (located to the right of its check box) and the **Sample Size(s)** check box are enabled when the Power Analysis check box is selected.

Enter a decimal value greater than 0 and less than 1 for alpha (α) in the Power Analysis edit box. By default, the Power Analysis edit box is initialized to the same value of alpha (α) that is entered in the **Significance Level** edit box but it can be modified if desired. The "actual" power computation uses the sample size of the selected sample data and the alpha (α) specified in the Power Analysis edit box.

Select or clear the **Sample Size(s)** check box to determine whether or not "hypothetical" powers for the t-Test are computed. The **Sample Size(s)** edit box (located to the right of its check box) is enabled when the Sample Size(s) check box is selected.

Enter a comma separated list of hypothetical sample sizes (positive Integers only) in the Sample Size(s) edit box. A "hypothetical" power is computed for each hypothetical sample size entered. The hypothetical power computation uses the alpha (α) specified in the Power Analysis edit box.

The Compute Button

Click the **Compute** button to perform the indicated computations on the selected sample data set. Control settings (including the Sample) can be changed and the Compute button can be clicked as many times as desired without closing the dialog box. All results are output to the Results Log.

Example: Performing a One Sample t-Test

To perform a one sample t-Test:

1. Open the Origin sample project file ONE SAMPLE T-TEST.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder. This data file contains 130 observations of normal body temperature ($^{\circ}$ F), gender (1=male, 2=female), and heart rate (beats/minute).
2. Highlight the leftmost column of values in the OnePopTst worksheet and select **Statistics:Hypothesis Testing:One Sample t-Test**.

3. Type **98.6** for μ_0 in the **Null Hypothesis** edit box and check the **Confidence Interval(s)**, **Power Analysis**, and **Sample Size(s)** check boxes.
4. Accept all other default values and click the **Compute** button.

One Sample t-Test Results

The observed significance (P value = 2.41063E-7) gives the probability of obtaining a test statistic as extreme or more extreme than t by chance alone if the sampled data were in fact drawn from a population having a mean (μ) equal to 98.6°F. Thus, with a two-tailed significance level (or alpha) set at $\alpha = 0.05$, we reject the null hypothesis and accept the alternative hypothesis. We conclude that the true population mean is not 98.6°F.

In addition, the 99% confidence interval tells us that we can be 99% sure that the limits 98.08111 (lower) and 98.41735 (upper) contain the true population mean. Power analysis (actual power = 0.99965) leads us to conclude that the experiment is very sensitive. Given that the true population mean is not 98.6°F, it is highly probable that this experiment would correctly reject the null hypothesis (as it did). We might even be able to reduce the sample size (and cost) of similar experiments to 100 (hypothetical power = 0.99693) without losing much sensitivity. Increasing the sample size to 200 would cause power to approach 1 (with 5 decimal digits of precision) but we would have to incur additional expense and gain little sensitivity.

Two Sample t-Tests

A two sample t-Test can be employed to test whether or not two population means, μ_1 and μ_2 , are equal (i.e. whether or not their difference is 0, $\mu_1 - \mu_2 = d_0 = 0$). The two sample t-Test is performed on two sample data sets that are assumed to have been drawn from populations that follow a normal distribution with constant variance.

Theory: Two Sample t-Test:

The two sample t-Test can either be a one- or two-tailed test depending on the nature of the variable under study and the objectives of the experimenter. The experimenter develops a null hypothesis (H_0) which is the logical counterpart, mutually exclusive and exhaustive, to an alternative hypothesis (H_1) that the experimenter is attempting to evaluate. Depending on the outcome of the test, the null hypothesis is either rejected or retained. Rejection of the null hypothesis logically leads to acceptance of the alternative hypothesis and retention of the null hypothesis leads to an inability to accept the alternative hypothesis. Two-tailed hypotheses take the form:

$$H_0: \mu_1 - \mu_2 = d_0 \quad \text{and} \quad H_1: \mu_1 - \mu_2 \neq d_0$$

while one-tailed hypotheses take the form:

$$H_0: \mu_1 - \mu_2 \leq d_0 \quad \text{and} \quad H_1: \mu_1 - \mu_2 > d_0$$

or

$$H_0: \mu_1 - \mu_2 \geq d_0 \quad \text{and} \quad H_1: \mu_1 - \mu_2 < d_0$$

depending on the direction of the test.

The test statistic t is used to evaluate the null hypothesis which then allows the indirect evaluation of the alternative hypothesis. We reject the null hypothesis H_0 (and thereby accept the alternative hypothesis H_1) when t is extreme enough to cause the observed significance to be less than some pre-specified significance level. We retain the null hypothesis (and thereby fail to

accept the alternative hypothesis) when the observed significance is greater than the pre-specified significance level. The observed significance (or P value) is the probability of obtaining a test statistic as extreme or more extreme than t due to chance factors alone. The pre-specified significance level is called alpha (α) or just significance level.

In the context of a two sample t-Test, a confidence interval consists of a lower limit and an upper limit that, with some specified degree of confidence, contains the difference of the true population means. The degree of confidence (or probability) that a given confidence interval contains the difference of the true population means is called the confidence level.

Note: See the separate discussions for independent and paired t-tests below for their respective mathematical definitions of the test statistic t and confidence intervals.

The power of a two sample t-Test is a measurement of its sensitivity. In terms of the null and alternative hypotheses, power is the probability that the test statistic t will be extreme enough to allow the rejection of the null hypothesis when it should in fact be rejected (i.e. given the null hypothesis is not true). For each of the three different null hypotheses, power is mathematically defined below.

For $H_0: \mu_1 - \mu_2 = d_0$, $Power = 1 - P[T \leq t_{1-\alpha/2}(\nu) - t] + P[T \leq t_{\alpha/2}(\nu) - t]$

For $H_0: \mu_1 - \mu_2 \leq d_0$, $Power = 1 - P[T \leq t_{1-\alpha}(\nu) - t]$

For $H_0: \mu_1 - \mu_2 \geq d_0$, $Power = P[T \leq t_{\alpha}(\nu) - t]$

where T is a random variable having a t distribution with ν degrees of freedom, the computation of the test statistic t is given below, the terms $t_{1-\alpha/2}(\nu)$, $t_{\alpha/2}(\nu)$, $t_{1-\alpha}(\nu)$, and $t_{\alpha}(\nu)$ are critical values of t from the Student's t distribution indexed at the $1-\alpha/2$, $\alpha/2$, $1-\alpha$, and α levels and by $\nu = n_1 + n_2 - 2$ for the Independent t-Test and by $\nu = n - 1$ degrees of freedom for the Paired t-Test. The computation for hypothetical power is the same as for actual power except that the test statistic t , the critical values of t , and ν are recomputed using hypothetical sample sizes instead of the actual sample size.

Two Sample Independent t-Tests

For the two sample independent t-Test, the computed test statistic,

$$t = \frac{(\bar{X}_1 - \bar{X}_2 - d_0)}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}, \text{ has a Student's t-distribution with } \nu = n_1 + n_2 - 2 \text{ degrees of}$$

freedom. For samples $i=1$ and 2 and data points $j = 1, 2, 3 \dots n_i$, $\bar{X}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} X_{ij}$, d_0 is the estimated difference between sample means,

$$s^2 = \frac{[(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2]}{(n_1 + n_2 - 2)}, \text{ and } s_i = \sqrt{\frac{\sum_{j=1}^{n_i} (X_{ij} - \bar{X}_i)^2}{n_i - 1}}.$$

For the two sample independent t-Test, the lower and upper limits of a confidence interval for the difference of the sample means are

$$(\bar{X}_2 - \bar{X}_1) \pm t_{1-\alpha/2}(\nu) \sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$
 where the factor $t_{1-\alpha/2}(\nu)$ is a critical value of t from the Student's t distribution indexed at the $1-\alpha/2$ level and by ν degrees of freedom. Here alpha (α) is specified by the confidence level where $\alpha = 1 - (\text{confidence level}/100)$.

Two Sample Paired t-Test

For the two sample paired t-Test, the computed test statistic, $t = \frac{\bar{D} - d_0}{S_D}$, has a Student's t-distribution with $\nu = n - 1$ degrees of freedom (assuming an equal number of n data points in each sample). For samples 1 and 2 and data points $j = 1, 2, 3, \dots, n$,

$D = X_{1j} - X_{2j}$, d_0 is the estimated difference between sample means,

$$\bar{D} = \frac{1}{n} \sum_{j=1}^n D_j, \quad S_D = \sqrt{\frac{1}{n-1} \sum_{j=1}^n (D_j - \bar{D})^2}, \text{ and}$$

For the two sample paired t-Test, the lower and upper limits of a confidence interval for

the difference of the sample means are $(\bar{X}_2 - \bar{X}_1) \pm t_{1-\alpha/2}(\nu) S_D$ where the factor $t_{1-\alpha/2}(\nu)$ is a critical value of t from the Student's t distribution indexed at the $1-\alpha/2$ level and by ν degrees of freedom. Here alpha (α) is specified by the confidence level where $\alpha = 1 - (\text{confidence level}/100)$.

Performing a Two Sample t-Test

To perform a two sample t-Test:

1. Highlight the desired worksheet columns and then select **Statistics:Hypothesis Testing:Two Sample t-Test**.

The menu command opens the Two Sample t-Test dialog box in which you specify the **Sample1** and **Sample2** data sets as well as all other test parameters described below. After clicking the **Compute** button, the test results are output to the **Results Log**.

The results include the type of test performed (**Independent** or **Paired**), the names of the sample data sets, sample means (\bar{X}_1 and \bar{X}_2), standard deviations (SD_1 and SD_2), standard errors (SE_1 and SE_2), and sample sizes (n_1 and n_2). The test statistic (t), degrees of freedom (DF or ν), observed significance (P value), the null (H_0) and alternative (H_1) hypotheses, and the decision rule of the test are output as well.

If the **Confidence Interval(s)** and **Power Analysis** check boxes are selected, then all specified confidence intervals and the actual power of the experiment are output.

Selecting the **Sample Size(s)** check box causes a hypothetical power for each specified sample size to also be output.

Two Sample t-Test Controls

The Test Type Radio Buttons

Select the **Independent Test** or **Paired Test** radio button depending on the test type you want to conduct.

The **Paired Test** type requires that sample 1 and sample 2 have the same number of data points and that the data points are experimentally paired.

The Sample1 and Sample2 Drop Down Lists

Select the sample data sets on which to perform a Two Sample t-Test. The sample data sets are assumed to have been drawn from population(s) that follow a normal distribution.

The Hypotheses Group

Enter the estimated difference of the sample means, d_0 , in the **Null Hypothesis** edit box to the right of the text **Mean1 - Mean2 =**. The value entered for the difference of the sample means is updated in each of the three Alternate Hypotheses.

Select the appropriate radio button for **Alternate** hypothesis indicating whether a two-tailed or one-tailed t-Test is to be performed. The direction of the one-tailed t-Test is also specified by the radio button selection. The (in)equality of the **Null** hypothesis updates accordingly.

Enter a decimal value greater than 0 and less than 1 for alpha (α) in the **Significance Level** edit box. The **Power Analysis** edit box in the Power Analysis group is initialized to the same value of alpha (α) and, if unique, a complementary $([1-\alpha]*100)$ confidence level is added to the **Level(s) in %** edit box in the **Confidence Interval(s)** group.

The Confidence Interval(s) Group

Select or clear the **Confidence Interval(s)** check box to determine whether or not confidence intervals are computed. The **Level(s) in %** edit box is enabled when the **Confidence Interval(s)** check box is selected.

Enter a comma separated list of confidence levels greater than 0 and less than 100 in the **Level(s) in %** edit box.

The Power Analysis Group

Select or clear the **Power Analysis** check box to determine whether or not the "actual" power of the t-Test is computed. The **Power Analysis** edit box (located to the right of its check box) and the **Sample Size(s)** check box are enabled when the **Power Analysis** check box is selected.

Enter a decimal value greater than 0 and less than 1 for alpha (α) in the **Power Analysis** edit box. By default, the Power Analysis edit box is initialized to the same value of alpha (α) that is entered in the **Significance Level** edit box but it can be modified if desired. The "actual" power computation uses the sample sizes of the selected sample data sets and the alpha (α) specified in the Power Analysis edit box.

Select or clear the **Sample Size(s)** check box to determine whether or not "hypothetical" powers for the t-Test are computed. The **Sample Size(s)** edit box (located to the right of its check box) is enabled when the Sample Size(s) check box is selected.

Enter a comma separated list of hypothetical sample sizes (positive Integers only) in the **Sample Size(s)** edit box. A "hypothetical" power is computed for each hypothetical sample size entered. The sample sizes entered are considered to be total (aggregate) sample sizes for the **Independent** Test and individual (separate) for the **Paired** Test. The hypothetical power computation uses the alpha (α) specified in the **Power Analysis** edit box.

The Compute Button

Click the **Compute** button to perform the indicated computations on the selected sample data sets. Control settings (including Sample1 and Sample2) can be changed and the Compute button can be clicked as many times as desired without closing the dialog box.

All results are output to the **Results Log**.

Example 1: Performing a Two Sample (Independent) t-Test

1. To perform a two sample (independent) t-Test, open the Origin sample project file TWO SAMPLE T-TEST.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder.
2. Activate the worksheet TwoPopInd and highlight both columns of values. This data file contains 65 observations of male and female normal body temperature (°F). (The column on the left contains the data for men and the column on the right contains the data for women.)
3. Select **Statistics:Hypothesis Testing:Two Sample t-Test**.
4. Select the **Independent Test** radio button, and clear the **Confidence Interval(s)**, **Power Analysis**, and **Sample Size(s)** check boxes.
5. Accept all other default values and click the **Compute** button.

Origin displays the following results:

[2/11/2002 13:43 "/TwoPopInd" <2452316>]

Two Sample Independent t-Test

Summary Statistics

Sample	N	Mean	SD	SE
1. TwoPopInd_MaleTemp	65	98.10462	0.69876	0.08667
2. TwoPopInd_FemaleTemp	65	98.39385	0.74349	0.09222

Difference of Means: -0.28923

Null Hypothesis: Mean1 - Mean2 = 0
 Alternative Hypothesis: Mean1 - Mean2 < 0

t	DoF	P Value
-2.28543	128	0.02393

At the 0.05 level, the difference of the population means is significantly different than the test difference <0>.

With the significance level (or alpha) set at $\alpha=0.05$, we conclude that male and female normal body temperature are different. The observed significance (P value=0.02393) tells us our probability of obtaining a more extreme t-value by chance alone when the normal body temperatures of males and females are not different. Therefore, if we had set our level of significance at 0.01 for this test, we would have concluded that male and female normal body temperature does not differ.

Note: For a description of how to perform and interpret confidence intervals and power analysis, see *One Sample t-Tests* on page 569.

Example 2: Performing a Two Sample (Paired) t-Test

1. To perform a two sample (paired) t-Test, open the Origin sample project file TWO SAMPLE T-TEST.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder.
2. Activate the worksheet TwoPopPair and highlight both columns of values. This worksheet contains observations of two types of percent body fat measurement techniques on 252 men. (One column uses the Brozek body fat technique and the other column uses the Siri body fat technique).
3. Select **Statistics:Hypothesis Testing:Two Sample t-Test**.
4. Select the **Paired Test** radio button, and clear the **Confidence Interval(s)**, **Power Analysis**, and **Sample Size(s)** check boxes.
5. Accept all other default values and click the **Compute** button.

Origin displays the following results:

[2/11/2002 13:53 "/TwoPopInd" <2452316>]

Two Sample Paired t-Test

Summary Statistics

Sample	N	Mean	SD	SE
1. TwoPopInd_MaleTemp	65	98.10462	0.69876	0.08667
2. TwoPopInd_FemaleTemp	65	98.39385	0.74349	0.09222

Difference of Means: -0.28923

Null Hypothesis: Mean1 - Mean2 = 0
 Alternative Hypothesis: Mean1 - Mean2 < 0

t	DoF	P Value
-12.68577	64	3.97734E-19

At the 0.05 level, the difference of the population means is significantly different than the test difference <0>.

With the significance level (or alpha) set at $\alpha=0.05$, we conclude that the Brozek and Siri percent body fat measurement techniques are different. The observed significance (P value=3.54206E-7) gives the probability of obtaining a test statistic as extreme or more extreme than by chance alone when the body fat measuring techniques are in fact not different.

Note: For a description of how to perform power analysis and interpret confidence intervals, see *One Sample t-Tests* on page 569.

ANOVA

One-Way ANOVA

The one-way analysis of variance can be employed to test whether or not two or more populations have the same mean. One-way analysis of variance assumes that the sample data sets have been drawn from populations that follow a normal distribution with constant variance.

The One-Way ANOVA dialog box includes Levene's test and the Brown-Forsythe test for equal variance. Computations for actual and hypothetical power and for the Bonferroni, Scheffé, and Tukey post hoc means comparisons are also included.

Theory: One-Way ANOVA

The null hypothesis is that the means of all selected data sets are equal. The alternative hypothesis is that the means of one or more selected data sets are different (not equal).

The test statistic for one-way analysis of variance is the ratio $F = \frac{MSBG}{MSE}$, where

$$MSBG = \sum_{i=1}^r \frac{n_i(\bar{X}_i - \bar{X}_{..})^2}{r-1}, \quad MSE = \sum_{i=1}^r \sum_{j=1}^{n_i} \frac{(X_{ij} - \bar{X}_i)^2}{N-r}$$

, r is the number of data sets, n_i is the number of data points in the i -th data set, \bar{X}_i is the mean of the i -th data set, $\bar{X}_{..}$ is the global mean of all data points (in all data sets), X_{ij} is the j -th data point in the i -th data set, and N is the total number of all data points.

A P value for the computed F statistic is then obtained from the F-distribution for the degrees of freedom of the numerator $r-1$ and the degrees of freedom of the denominator $N-r$. Large values of F will lead to small P values. If the P value is smaller than a specified significance level alpha, the null hypothesis is rejected and the decision rule states that the means are significantly different. In other words, at least one of the means is significantly different than the others. If the P value is larger than the specified significance level alpha, the null hypothesis is accepted and the decision rule states that the means are not significantly different.

A general reference for Origin's one-way analysis of variance is *Applied Linear Statistical Models*, Neter J., Kutner M., Nachtsheim C., and Wasserman W. (1996), The McGraw-Hill Companies, Inc., Boston, MA. See Sections 16.8 and 16.9.

Tests for equal variance test whether or not two or more population variances (rather than population means) are significantly different. The computation for Levene's test for equal variance is similar to the computation for the one-way analysis of variance. The equations above

are precisely followed except that each X_{ij} is replaced with an X'_{ij} where $X'_{ij} = (X_{ij} - \bar{X}_i)^2$ prior to all calculations. The computation for the Brown-Forsythe test for

equal variance is also similar to the computation for the one-way analysis of variance. Again, the equations above are precisely followed except that each X_{ij} is replaced with X'_{ij} where $X'_{ij} = |X_{ij} - M_i|$ (where M_i is the median of the i -th data set) prior to all calculations. See Section 18.2 of *Applied Linear Statistical Models* (1996) for a discussion on tests of equal variance.

Given that an ANOVA experiment has determined that at least one of the population means is statistically different, a post hoc means comparison subsequently compares all possible pairs of population means in the ANOVA experiment to determine which mean (or means) are significantly different. See Sections 17.5, 17.6 and 17.7 of *Applied Linear Statistical Models* (1996) for a detailed discussion on the Bonferroni, Scheffé, and Tukey post hoc means comparisons. In addition, Origin uses the NAG function **nag_anova_confid_interval (g04dbc)** to perform means comparisons. See the NAG documentation for more detailed information. (When you install Origin, you are provided the option to install the NAG PDF files which document the NAG functions. If you clicked Yes to install these files, a \NAG PDFs folder is created with a subfolder for each library. If you did not install the PDFs, they remain accessible on your installation CD. Furthermore, you can install them at a later date by running the Origin "Add or Remove Files" program.)

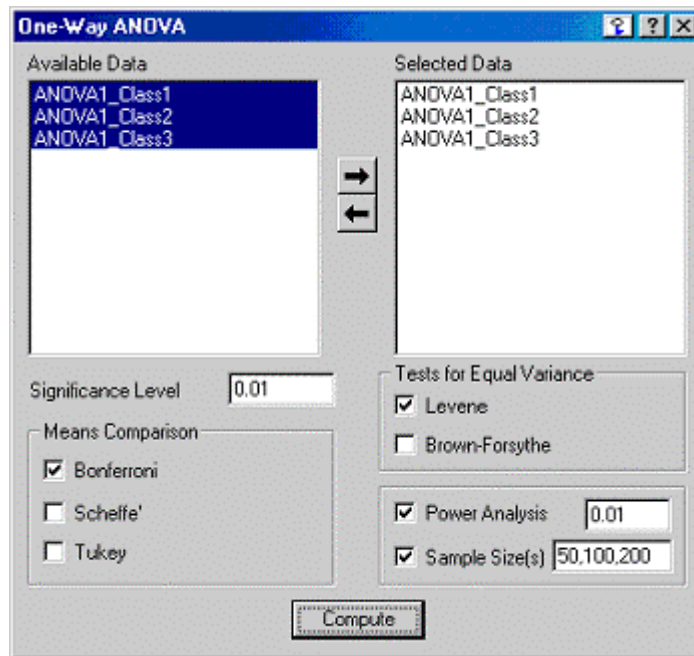
The power of a one-way analysis of variance is a measurement of its sensitivity. Power is the probability that the ANOVA will detect differences in the population means when real differences exist. In terms of the null and alternative hypotheses, power is the probability that the test statistic F will be extreme enough to allow the rejection of the null hypothesis when it should in fact be rejected (i.e. given the null hypothesis is not true).

Power is defined by the equation:

$$\text{power} = 1 - \text{probf}(f, \text{dfa}, \text{dfe}, \text{nc})$$

where f is the deviate from the non-central F-distribution with dfa and dfe degrees of freedom and $\text{nc} = \text{ssa} / \text{mse}$. ssa is the sum of squares of the Model, mse is the mean square of the Errors, dfa is the degrees of freedom of the numerator, dfe is the degrees of freedom of the Errors. All values (ssa , mse , dfa , and dfe) are obtained from the ANOVA table. The value of $\text{probf}()$ is obtained using the NAG function **nag_prob_non_central_f_dist**. See the NAG documentation for more detailed information.

One-way ANOVA Dialog Box Controls



The Available Data List Box

Contains a list of all non-Text data sets in the Origin project file that are available to be selected. Highlight the desired available data sets and then click the right-arrow toolbar button to select them.

The Selected Data List Box

Contains the selected data sets on which an analysis of variance will be performed. Two or more data sets must be selected before you can perform the ANOVA. De-select selected data sets by highlighting them in the **Selected Data** list box and then clicking the left-arrow toolbar button.

The Significance Level Edit Box

Enter a **Significance Level** for comparison with the P value when making statistical decisions. The decimal value entered must be greater than 0 and less than 1.

The Means Comparison Group

Select or clear the **Bonferroni** check box determining whether or not the Bonferroni post hoc means comparison is performed.

Select or clear the **Scheffé** check box determining whether or not the Scheffé post hoc means comparison is performed.

Select or clear the **Tukey** check box determining whether or not the Tukey post hoc means comparison is performed.

The Tests for Equal Variance Group

Select or clear the **Levene** check box determining whether or not Levene's test for equal variance is performed.

Select or clear the **Brown-Forsythe** check box determining whether or not the Brown-Forsythe test for equal variance is performed.

The Power Analysis and Sample Size(s) Check Boxes

Select or clear the **Power Analysis** check box to determine whether or not the "actual" power of the ANOVA is computed. The **Power Analysis** edit box (located to the right of its check box) and the **Sample Size(s)** check box are enabled when the Power Analysis check box is selected.

Enter a decimal value greater than 0 and less than 1 for alpha (α) in the Power Analysis edit box. By default, the Power Analysis edit box is initialized to the same value of alpha (α) that is entered in the **Significance Level** edit box but it can be modified if desired. The "actual" power computation uses the total sample size of all selected sample data sets and the alpha (α) specified in the Power Analysis edit box.

Select or clear the Sample Size(s) check box to determine whether or not "hypothetical" powers for the ANOVA are computed. The **Sample Size(s)** edit box (located to the right of its check box) is enabled when the Sample Size(s) check box is checked.

Enter a comma separated list of hypothetical sample sizes (positive Integers only) in the Sample Size(s) edit box. A "hypothetical" power is computed for each hypothetical sample size entered. The sample sizes entered are considered to be total (aggregate) sample sizes. The hypothetical power computation uses the alpha (α) specified in the Power Analysis edit box.

The Compute Button

Click the **Compute** button to perform the indicated computations on the selected sample data sets. Control settings (including selected data sets in the **Selected Data** list box) can be changed and the Compute button can be clicked as many times as desired without closing the dialog box. All results are output to the **Results Log**.

Example: Performing a One-way Analysis of Variance

1. To perform a one-way analysis of variance, open the Origin sample project file ONE-WAY ANOVA.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder.
2. Activate the Anova1 worksheet and highlight all three columns. Select **Statistics:ANOVA:One-Way ANOVA** to open the One-Way ANOVA dialog box. The highlighted data sets are automatically moved into the Selected Data list box.
3. Enter a **Significance Level** (alpha) of **0.01**. Note that the **Power Analysis** edit box updates and also displays the value 0.01.
4. Select the **Bonferroni** check box in the **Means Comparison** group to enable the Bonferroni post hoc means comparison.
5. Select the **Levene** check box in the **Tests of Equal Variance** group to enable Levene's test for equal variance.
6. Select the **Power Analysis** check box to enable the computation of "actual" power for the ANOVA. If desired, enter an alpha of 0.05 for **Power Analysis** in the associated edit box (or just accept the ANOVA alpha of 0.01).
7. Select the **Sample Size(s)** check box to enable computation of "hypothetical" powers for the ANOVA. Accept the default hypothetical sample sizes which consists of the comma separated list "50,100,200" (total sample sizes).
8. Click the **Compute** button to perform the indicated computations.

The One-Way ANOVA is performed. Summary Statistics (including the Null and Alternative hypotheses), an ANOVA table, and a decision rule are output in the Results Log. Similar results for Levene's test for equal variance are also output. Next, the Bonferroni post hoc means comparison is performed and a comparison of each data set's mean against the others is output in the Results Log. Finally, both actual and hypothetical powers for the ANOVA are output.

Two-way ANOVA

Two-way analysis of variance (ANOVA) is a widely used statistical technique for studying the effect that independent (or controlled-by-the-experimenter) variables, called factors, have on a dependent (or response) variable. Two-way analysis of variance experiments have two independent factors each of which have two or more levels. Two-way ANOVA tests for significant differences between the factor level means within a factor and for interactions between the factors.

Two-way ANOVA includes several of the basic elements in the Design of Experiments (DOE) which is an important statistical tool in data analysis. In addition to the two-way analysis of variance, the Origin Two-Way ANOVA dialog box includes computations for the Bonferroni, Scheffé, and Tukey post hoc means comparisons and for actual and hypothetical power.

The Origin Two-Way ANOVA dialog box uses a linear regression approach when computing the two-way analysis of variance and consequently supports unequal sample sizes. This is important because designers of experiments seldom have complete control over the ultimate sample size of their studies. However, Origin's two-way ANOVA does not support empty cells (factor levels with no sample data points). Each of the two factors must have two or more levels and each factor level must have one or more sample data values.

Theory: Two-way ANOVA

A general reference for Origin's two-way analysis of variance is *Applied Linear Statistical Models*, Neter J., Kutner M., Nachtsheim C., and Wasserman W. (1996), The McGraw-Hill Companies, Inc., Boston, MA. See Section 22.2 of *Applied Linear Statistical Models* for a discussion of how to use dummy variables for testing both factor main effects and interaction effects. In addition, Origin's two-way analysis of variance makes use of several NAG functions. The NAG function **nag_dummy_vars (g04eac)** is used to create the necessary design matrices and the NAG function **nag_regn_mult_linear (g02dac)** is used to perform the linear regressions of the design matrices. The results of the linear regressions are then used to construct the two-way ANOVA table. See the NAG documentation for more detailed information. (When you install Origin, you are provided the option to install the NAG PDF files which document the NAG functions. If you clicked Yes to install these files, a \NAG PDFs folder is created with a subfolder for each library. If you did not install the PDFs, they remain accessible on your installation CD. Furthermore, you can install them at a later date by running the Origin "Add or Remove Files" program.)

Given that a two-way ANOVA experiment has determined that at least one factor level mean is statistically different than the other factor level means of that factor, a post hoc means comparison subsequently compares all possible pairs of factor level means of that factor to determine which mean (or means) are significantly different. See Sections 17.5, 17.6 and 17.7 of *Applied Linear Statistical Models* (1996) for a detailed discussion on the Bonferroni, Scheffé, and Tukey post hoc means comparisons. In addition, Origin uses the NAG function **nag_anova_confid_interval (g04dbc)** to perform means comparisons. See the NAG documentation for more detailed information.

The power of a two-way analysis of variance is a measurement of its sensitivity. Power is the probability that the ANOVA will detect differences in the factor level means when real differences exist. In terms of the null and alternative hypotheses, power is the probability that the test statistic F will be extreme enough to allow the rejection of the null hypothesis when it should in fact be rejected (i.e. given the null hypothesis is not true).

The Origin Two-Way ANOVA dialog box computes power for the Factor A and Factor B sources. If the Interactions check box is selected, Origin also computes power for the Interaction source A * B.

Power is defined by the equation:

$$\text{power} = 1 - \text{prob}f(f, df, dfe, nc)$$

where f is the deviate from the non-central F-distribution with df and dfe degrees of freedom and $nc = ss / mse$. ss is the sum of squares of the source A, B, or $A * B$, mse is the mean square of the Errors, df is the degrees of freedom of the numerator for the source A, B, or $A * B$, dfe is the degrees of freedom of the Errors. All values (ss , mse , df , and dfe) are obtained from the ANOVA table. The value of $prob(f)$ is obtained using the NAG function **nag_prob_non_central_f_dist**. See the NAG documentation for more detailed information.

Two-way ANOVA Dialog Box Controls

Two-Way ANOVA

Significance Level: 0.05
☒ Interactions

Specify Levels by:
☒ Datasets ☐ Classification Variables N = 6

Enter or Select Level: Moderate 300

Selected Data (N > 2)	Factor A Level	Factor B Level
ByDatasets_Light100mg	Light	100
ByDatasets_Light200mg	Light	200
ByDatasets_Light300mg	Light	300
ByDatasets_Moderate100mg	Moderate	100
ByDatasets_Moderate200mg	Moderate	200
ByDatasets_Moderate300mg	Moderate	300

Available Data:
 ByDatasets_Light100mg
 ByDatasets_Light200mg
 ByDatasets_Light300mg
 ByDatasets_Moderate100mg
 ByDatasets_Moderate200mg
 ByDatasets_Moderate300mg
 ByVariables_Dose
 ByVariables_Exercise
 ByVariables_TotalChol

☒ Power Analysis: 0.05
☒ Sample Size(s): 50,100,200

Means Comparison:
☐ Bonferroni ☒ Tukey
☐ Scheffe'

Compute

The Significance Level Edit Box

Enter a **Significance Level** for comparison with the P value when making statistical decisions. The decimal value entered must be greater than 0 and less than 1.

The Interactions Check Box

Select or clear the **Interactions** check box determining whether or not interaction effects for the two-way ANOVA are computed.

The Specify Levels by Group

Specify how the levels of each factor will be identified.

- Select the **Datasets** radio button if the dependent variable data values for each factor level are grouped into separate data sets.
- Select the **Classification Variables** radio button if all dependent variable data values are grouped into one data set and their factor levels are identified by two paired classification variable data sets.


This setting is predetermined by the manner in which the experimental data are organized.

The N = Edit Box


Reports the number of data sets that have been selected.

- When specifying levels by data sets, two or more data sets must be selected.
- When specifying levels by classification variables, exactly three data sets must be selected.

The Available Data List Box

Contains a list of all data sets in the Origin project file that are available to be selected. Highlight the desired available data sets and then click the  button to select them.

The Selected Data List Control

Contains the selected data sets on which an analysis of variance will be performed. De-select selected data sets by highlighting them in the **Selected Data** list control and then clicking the  button.

The first column of the Selected Data list control always contains the names of all selected data sets. Click the **Selected Data** column header button to highlight or un-highlight all selected data sets. The remaining columns of the list control are determined by the **Specify Levels by** radio buttons.

If the **Specify Levels by Datasets** radio button is selected, then two or more data sets must be selected for the remaining list control columns to properly function. The second column of the list control contains the assigned **Factor A Level** for each selected data set. Click the Factor A Level column header button to assign the level name displayed in the Factor A Level combo box to all highlighted data sets in the list control. The third column of the list control contains the assigned **Factor B Level** for each selected data set. Click the Factor B Level column header button to assign the level name displayed in the Factor B Level combo box to all highlighted data sets in the list control. Clicking the Factor A Level or Factor B Level column header button also adds the level name displayed in its combo box to the combo box drop-down list for future selection.

If the **Specify Levels by Classification Variables** radio button is selected, then exactly three data sets must be selected for the remaining list control columns to properly function. The second column of the list control contains the assigned **Variable Type** for each selected data set. Click the Variable Type column header button to assign the variable type **Dependent Variable** to the next data set in the list control. There is no third column, but the **Switch Factors** button <> can be clicked to switch the Factor A and Factor B Classification Variable types.

The Factor A Level Comb Box (visible only when specifying levels by data sets)

Enter or select levels in the **Factor A Levels** drop-down combo box. Entered and selected levels are assigned to the Factor A Level column in the **Selected Data** list control for all highlighted data sets. Click the **Factor A Level** column header button to add the displayed level name to the combo box list for future selection.

The Factor B Level Combo Box (visible only when specifying levels by data sets)

Enter or select levels in the **Factor B Levels** drop-down combo box. Entered and selected levels are assigned to the Factor B Level column in the **Selected Data** list control for all highlighted data sets. Click the **Factor B Level** column header button to add the displayed level name to the combo box list for future selection.

The Power Analysis and Sample Sizes Check Box

Select or clear the **Power Analysis** check box to determine whether or not the "actual" power of the ANOVA is computed. The **Power Analysis** edit box (located to the right of its check box) and the **Sample Size(s)** check box are enabled when the Power Analysis check box is selected.

Enter a decimal value greater than 0 and less than 1 for alpha (α) in the Power Analysis edit box. By default, the Power Analysis edit box is initialized to the same value of alpha (α) that is entered

in the Significance Level edit box but it can be modified if desired. The "actual" power computation uses the total sample size of all selected sample data sets and the alpha (α) specified in the Power Analysis edit box.

Select or clear the Sample Size(s) check box to determine whether or not "hypothetical" powers for the ANOVA are computed. The Sample Size(s) edit box (located to the right of its check box) is enabled when the Sample Size(s) check box is selected.

Enter a comma separated list of hypothetical sample sizes (positive Integers only) in the Sample Size(s) edit box. A "hypothetical" power is computed for each hypothetical sample size entered. The sample sizes entered are considered to be total (aggregate) sample sizes. The hypothetical power computation uses the alpha (α) specified in the Power Analysis edit box.

The Means Comparison Group

Select or clear the **Bonferroni** check box determining whether or not the Bonferroni post hoc means comparison is performed.

Select or clear the **Scheffé** check box determining whether or not the Scheffé post hoc means comparison is performed.

Select or clear the **Tukey** check box determining whether or not the Tukey post hoc means comparison is performed.

The Compute Button

Click the **Compute** button to perform the indicated computations on the selected sample data sets. Control settings (including selected data sets in the **Selected Data** list control) can be changed and the Compute button can be clicked as many times as desired without closing the dialog box. All results are output to the **Results Log**.

Example: Performing a Two-Way Analysis of Variance

1. To perform a two-way analysis of variance, open the Origin sample project file TWO-WAY ANOVA.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder.
2. Activate the ByDatasets worksheet and highlight all six columns. Select **Statistics:ANOVA:Two-Way ANOVA** to open the Two-Way ANOVA dialog box. The highlighted data sets are automatically moved into the Selected Data list control.
3. Enter a **Significance Level** (alpha) of **0.05**. Note that the Power Analysis edit box updates and also displays the value 0.05.
4. Select the **Interactions** check box to enable the computation of interaction effects.
5. Select the **Power Analysis** check box to enable the computation of "actual" power for the ANOVA. If desired, enter an alpha of **0.01** for Power Analysis in the associated edit box (or just accept the ANOVA alpha of 0.05).
6. Select the **Sample Size(s)** check box to enable computation of "hypothetical" powers for the ANOVA. Accept the default hypothetical sample sizes which consists of the comma separated list "50,100,200" (total sample sizes).
7. Select the **Tukey** check box in the **Means Comparison** group to enable the Tukey post hoc means comparison.
8. Select the **Datasets** radio button to specify levels by data set.
9. Drag or CTRL+click to select all the data sets in the **Selected Data** list control having the word "Light" in their name, so that they become highlighted. Enter "Light" in the **Factor A Level** combo box and note the Factor A Level setting for the highlighted data sets becomes "Light".

10. Click the **Factor A Level** column header button and note the item “Light” is added at the bottom of the **Factor A Level** drop-down combo box.
11. Repeat steps 9 and 10 for the word “Moderate”, again using the Factor A Level combo box and column header button. Now repeat steps 9 and 10 for the levels identified by the text “100mg”, “200mg”, and “300mg”, but this time using the **Factor B Level** combo box and column header button instead of the Factor A Level combo box and column header button.
12. Click the **Compute** button to perform the indicated computations. The Two-Way ANOVA is performed. Selected data sets and their associated level names and an ANOVA table are output in the **Results Log**. Next, the Tukey post hoc means comparison is performed on both Factor A and Factor B levels. A comparison of each data set’s (level’s) mean against the others is output in the Results Log. Finally, both actual and hypothetical powers for the sources of the ANOVA (A, B, and A * B) are output.
13. Click the **Selected Data** column header button until all selected data sets become highlighted and then click the left-arrow toolbar button removing them from the Selected Data list control.
14. Drag or CTRL+click to select all three data sets in the **Available Data** list box having the word “ByVariables” in their name, so that they become highlighted. Click the right-arrow toolbar button adding them to the **Selected Data** list control.
15. Click the **Classification Variables** radio button to specify levels by classification variables. The Selected Data list control updates and the Factor A and B combo boxes disappear. If the three “ByVariables” data sets are listed in the Selected Data list control, they will automatically be assigned initial variable types. If the three data sets are not selected and the variable types are not automatically assigned, repeat step 14.
16. Click the **Variable Type** column header button until the data set “ByVariables_TotalChol” is identified as the **Dependent Variable**. Click the Switch Factors button <> until the data set “ByVariables_Exercise” is identified as the **Factor A Classification Variable**.
17. Click the **Compute** button once again to perform the indicated computations. The data in the “ByVariables” worksheet is identical to the data in the “ByDatasets” worksheet, except for its organization. If all other settings remain the same, the new results should be identical to the previously generated results.

Multiple Regression

To perform a multiple regression on worksheet data, highlight the independent variable columns and select **Statistics:Multiple Regression**. This menu command opens an Attention dialog box confirming the data set selection and automatic designation. Click OK to perform the multiple regression.

With the first column in the worksheet assumed to contain the dependent variable values (Y), and the highlighted columns assumed to contain the independent variables (X), the multiple regression model is stated:

$$Y = A + B_1X_1 + B_2X_2 + \dots + B_kX_k$$

Origin copies the regression results and the ANOVA table to the Results Log.

A, B_1, B_2 , etc.	The parameter estimates and standard errors.
t-value	The t-values for testing if the parameter equals zero, where t = the parameter estimate/standard error of the estimate.
p-value	The corresponding p-values.

R-square	$(\text{SYY}-\text{RSS})/\text{SYY}$.
Adj. R-square	$1-[(1-\text{R-square})*(\text{N}-1)/(\text{N}-\text{k}-1)]$.
Root-MSE	estimated standard deviation.

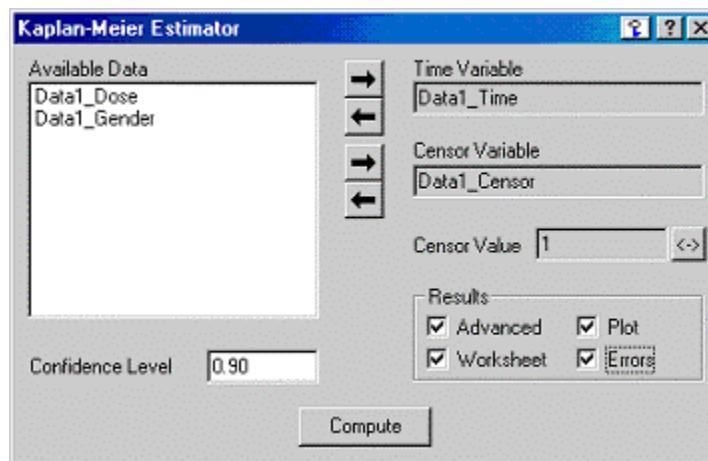
Survival Analysis

Kaplan-Meier Product-Limit Estimator

The computational engine for the Origin Kaplan-Meier Product-Limit Estimator dialog box is the NAG function **nag_prod_limit_surviv_fn (g12aac)**. See the NAG documentation for more detailed information. (When you install Origin, you are provided the option to install the NAG PDF files which document the NAG functions. If you clicked Yes to install these files, a \NAG PDFs folder is created with a subfolder for each library. If you did not install the PDFs, they remain accessible on your installation CD. Furthermore, you can install them at a later date by running the Origin "Add or Remove Files" program.)

An additional reference for the Origin Kaplan-Meier Product-Limit Estimator dialog box is Chapter 2 of Applied Survival Analysis: Regression Modeling of Time to Event Data (Hosmer and Lemeshow, 1999).

Kaplan-Meier Estimator Dialog Box Controls



The Available Data List Box

Contains a list of all non-Text data sets in the Origin project file that are available to be selected as **Time Variables** and **Censor Variables**. Highlight the desired available data set(s) and then click the appropriate right-arrow toolbar button to select it (them).

The Time Variable Edit Box

Contains the selected **Time Variable** data set. The Time Variable data set is a sample of event (failure) and censored times. Any unit of time may be used but all time values must be positive and must be expressed as elapsed time (relative to the beginning time of the study) and not be absolute time values (calendar dates and clock times). This data set is paired with the **Censor Variable** data set and must contain precisely the same number of data values. De-select a selected Time Variable data set by selecting a different Time Variable data set or by clicking the appropriate left-arrow toolbar button.

The Censor Variable Edit Box


Contains the selected **Censor Variable** data set. The Censor Variable data set must contain exactly two unique values (text or numeric) one of which identifies a paired time value as an event (or failure) time and one of which identifies a paired time value as censored. The Censor Variable data set must contain precisely the same number of data values as the **Time Variable** data set. De-select a selected Censor Variable data set by selecting a different Censor Variable data set or by clicking the appropriate left-arrow toolbar button.

The Censor Value Edit Box

Contains the currently selected **Censor Value** chosen from one of the two unique values contained in the **Censor Variable** data set.

The Censor Value identifies which time values in the **Time Variable** data set are censored. An observation having a censored time value represents some outcome other than failure such as prematurely leaving the study due to chance factors or surviving beyond the completion of the study.

The Toggle Censor Value Button

Click the Toggle Censor Value button  to choose the **Censor Value** from one of the two unique values contained in the **Censor Variable** data set.

The Confidence Level Edit Box

Enter a **Confidence Level** to be used when computing errors for the survivorship function and for the upper and lower limits of the quartile estimates. The decimal value entered must be greater than 0 and less than 1.

The Results Group

Select the **Advanced** check box if you want the survivorship function output in the Results Log.

Select the **Worksheet** check box if you want the survivorship function and quartile estimates to be output in a worksheet.


Select the **Plot** check box if you want a plot of the survivorship function.



Select the **Errors** check box if you want the errors of the survivorship function to be plotted along with the survivorship function as confidence bands.

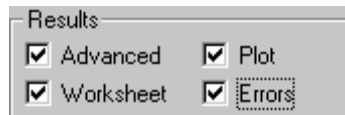
The Compute Button

Click the **Compute** button to perform the indicated computations on the selected **Time Variable** and **Censor Variable**. All settings can be changed and the **Compute** button can be clicked as many times as desired without closing the dialog box. Results are output as indicated in the **Results Group**.

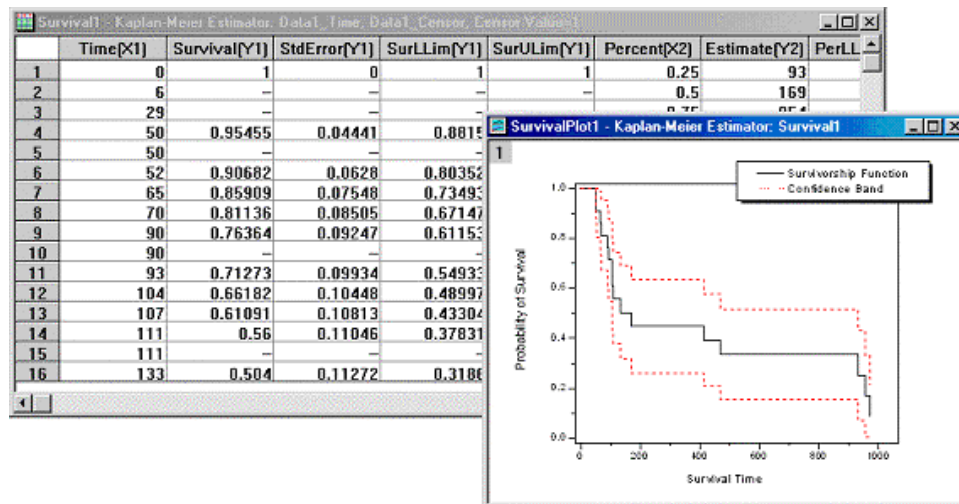
Example: Running the Kaplan-Meier Product-Limit Estimator

1. To run the Kaplan-Meier Product-Limit Estimator, open the Origin sample project file SURVIVAL ANALYSIS.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder.
2. Activate the Data1 worksheet and select **Statistics:Survival Analysis:Kaplan-Meier Estimator** to open the Kaplan-Meier Estimator dialog box.
3. Highlight the data set **Data1_Time** in the **Available Data** list box and then click the  button.

- Highlight the data set **Data1_Censor** in the **Available Data** list box and then click the  button.
- Click the (Toggle) **Censor Value** button  if needed to toggle the selected Censor Value from **0** to **1**.
- Enter a **Confidence Level** of **0.90**.
- Make sure all four check boxes in the **Results Group** are selected and then click the Compute button.



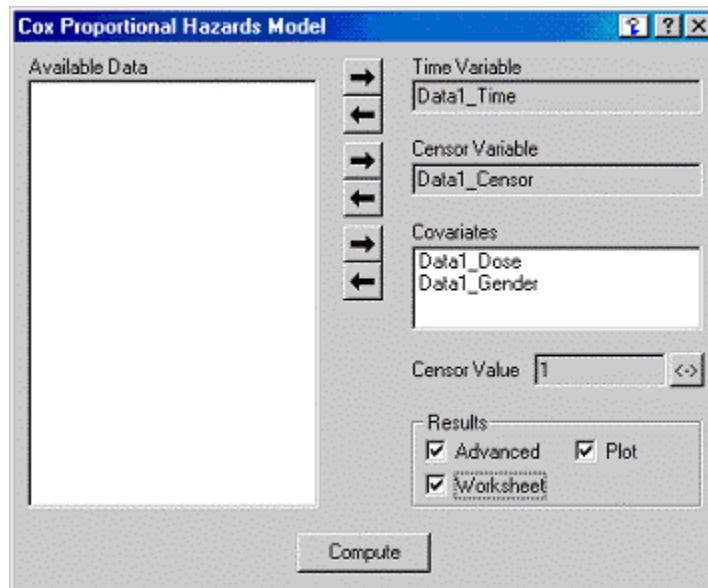
The Kaplan-Meier Estimator runs, outputting the **Summary of Event and Censor Values**, the **Survivorship Function**, and **Quartile Estimates** in the Results Log and in a **Survival** worksheet. The **Survivorship Function** and **Confidence Bands** (upper and lower confidence limits) are plotted in a **SurvivalPlot** graph.



Cox Proportional Hazards Model

The computational engine for the Origin Cox Proportional Hazards Model dialog box is the NAG function **nag_surviv_cox_model (g12bac)**. See the NAG documentation for more detailed information. An additional reference for the Origin Cox Proportional Hazards Model is Chapter 3 of Applied Survival Analysis: Regression Modeling of Time to Event Data (Hosmer and Lemeshow, 1999).

Cox Proportional Hazards Model Dialog Box Controls



The Available Data List Box

Contains a list of all non-Text data sets in the Origin project file that are available to be selected as **Time Variables**, **Censor Variables**, and **Covariates**.

Highlight the desired available data set(s) and then click the appropriate right-arrow toolbar button to select.

The Time Variable Edit Box

Contains the selected **Time Variable** data set. The Time Variable data set is a sample of event (failure) and censored times. Any unit of time may be used but all time values must be positive and must be expressed as elapsed time (relative to the beginning time of the study) and not be absolute time values (calendar dates and clock times). This data set is paired with the **Censor Variable** data set and must contain precisely the same number of data values.

De-select a selected Time Variable data set by selecting a different Time Variable data set or by clicking the appropriate left-arrow toolbar button.

The Censor Variable Edit Box

Contains the selected **Censor Variable** data set. The Censor Variable data set must contain exactly two unique values (text or numeric) one of which identifies a paired time value as an event (or failure) time and one of which identifies a paired time value as censored. The **Censor Variable** data set must contain precisely the same number of data values as the **Time Variable** data set.

De-select a selected Censor Variable data set by selecting a different Censor Variable data set or by clicking the appropriate left-arrow toolbar button.

The Covariates List Box

Contains one or more selected **Covariate** data sets. Each Covariate data set is paired with the **Censor** and **Time Variable** data sets and must contain precisely the same number of data values. Covariate data set values are Real Numbers but can also be Categorical (e.g. indicate the presence


of a condition or characteristic by using the value 1 and the absence of a condition or characteristic by using the value 0; indicate the level of a characteristic by using consecutive integers, etc.).

De-select selected Covariate data sets by highlighting them in the Covariates list box and then clicking the appropriate left-arrow toolbar button.

The Censor Value Edit Box

Contains the currently selected **Censor Value** chosen from one of the two unique values contained in the **Censor Variable** data set. The Censor Value identifies which time values in the **Time Variable** data set are censored. An observation having a censored time value represents some outcome other than failure such as prematurely leaving the study due to chance factors or surviving beyond the completion of the study.

The Toggle Censor Value Button

Click the Toggle **Censor Value** button  to choose the Censor Value from one of the two unique values contained in the Censor Variable data set.

The Results Group

Select the **Advanced** check box if you want the survivorship function output in the Results Log.

Select the **Worksheet** check box if you want the survivorship function and quartile estimates to be output in a worksheet.





Select the **Plot** check box if you want a plot of the survivorship function.

The Compute Button

Click the **Compute** button to perform the indicated computations on the selected **Time Variable**, **Censor Variable**, and **Covariates** data sets.

All settings can be changed and the **Compute** button can be clicked as many times as desired without closing the dialog box. Results are output as indicated in the **Results Group**.

Example: Running the Cox Proportional Hazards Model

1. To run the Cox Proportional Hazards Model, open the Origin sample project file SURVIVAL ANALYSIS.OPJ located in the Origin \SAMPLES\ANALYSIS\STATISTICS subfolder.
2. Activate the Data1 worksheet and select **Statistics:Survival Analysis:Cox Proportional Hazards Model** to open the Cox Proportional Hazards Model dialog box.
3. Highlight the data set **Data1_Time** in the **Available Data** list box and then click the  button.
4. Highlight the data set **Data1_Censor** in the **Available Data** list box and then click the  button.
5. Highlight the data sets **Data1_Gender** and **Data1_Dose** in the **Available Data** list box and then click the  button.
6. Click the Toggle Censor Value button  if needed to toggle the selected **Censor Value** from 0 to 1.

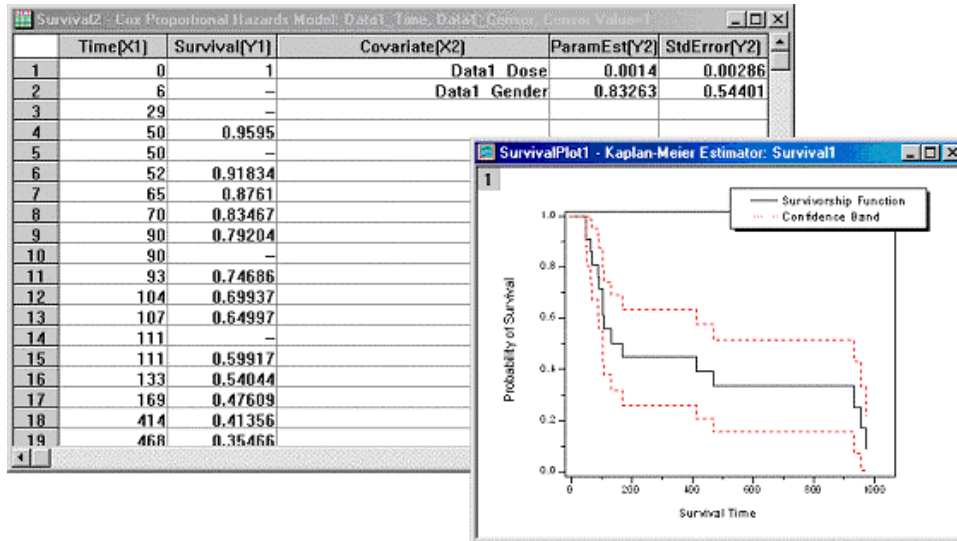
7. Make sure all three check boxes in the **Results Group** are selected and then click the **Compute** button.

Results

☒ Advanced ☒ Plot

☒ Worksheet

The Cox Proportional Hazards Model runs, outputting the **Summary of Event and Censor Values**, the **Survivorship Function**, and **Parameter Estimates** in the Results Log and in a **Survival** worksheet. The Survivorship Function is plotted in a **SurvivalPlot** graph.



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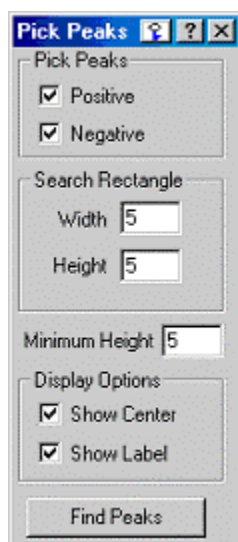
Analysis: Advanced Math on Data Sets

Baseline and Peak Analysis

The Pick Peaks Tool

The Pick Peaks tool is available when a graph window is active. To open the tool, select **Tools:Pick Peaks**. This tool operates on the active data plot in the graph window. It enables you to find peaks when the data do not seem to have a definable baseline (for example, when the peaks appear to follow or overlap each other without intervening flat regions). The method of peak picking used for this tool does not rely on the smoothness of the data, and is, therefore, somewhat more robust than the Baseline tool.

Pick Peaks Tool Dialog Box Controls



The Pick Peaks Group

This tool can locate both positive and negative peaks in your data plot. Select the desired radio button from this group.

The Search Rectangle Group

The method for peak picking uses a moving rectangle. If a peak is to be found inside a rectangle, the difference in height between the local data maximum inside the rectangle and the data values at both rectangle ends has to be no less than the rectangle height. The height of the rectangle is the *percentage*, as specified in the **Height** text box, of the total amplitude of the data in the range (the amplitude is defined as the difference between the maximum and the minimum of the data). The width of the rectangle is the *percentage*, as specified in the **Width** text box, of the total number of points in the data range.

Generally, the smaller the **Height** and the **Width** text box values, the more peaks are likely to be found. The width should not be too small, however, since the rectangle must include at least a few points.

The **Minimum Height** Text Box

The minimum height is the *percentage*, as specified in the **Minimum Height** text box, of the total amplitude of the data in the range, that the peak must have, as determined relative to the minimum of the data. The smaller the Minimum Height text box value, the more peaks are likely to be found.

The **Display Options** Group

Select the **Show Center** check box to mark the center of the plotted peak.

Select the **Show Label** check box to label the data plot with the X coordinate of the center of each peak.

The **Find Peaks** Button

Click this button to perform the peak search based on the specified settings. The peak results are stored in a hidden **Peaks#** worksheet, where # starts from 1 and increments each time a new data plot is processed.

The Baseline Tool

The **Baseline** tool is useful for analyzing peak areas when the data plot has a definable baseline. In addition to picking peaks, it enables you to determine the extent of the peaks and the underlying baseline, as well as to integrate the data from the baseline or from the Y=0 line.

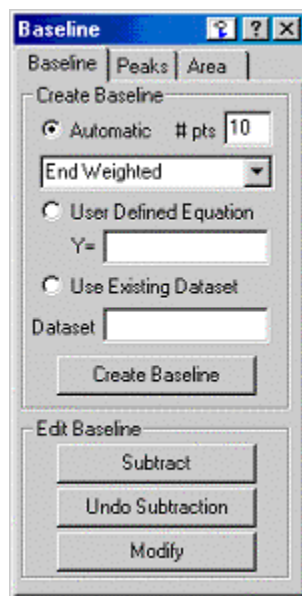
This tool has three tabs: the **Baseline** tab, the **Peaks** tab, and the **Area** tab. The tool is optimally used by first finding the baseline by editing the Baseline tab, and then finding both positive and negative peaks in the data plot by editing the Peaks tab. Finally, areas under the peaks or the entire data plot can be obtained using the Area tab.

To open the Baseline tool:

1. Click on a graph window to make it active.
2. Select **Tools:Baseline** to open the **Baseline** tool.

Baseline Tool Dialog Box Controls

The Baseline Tab Controls



The Baseline tab provides three options for creating a baseline. After clicking the **Create Baseline** button, the X and Y baseline coordinates are stored in a hidden worksheet named **Base#**.

The **Automatic**(ally Find the Baseline) Radio Button

Select the **Automatic** radio button to find baseline points based on the baseline detection method selected from the associated drop-down list and the number of points in the **# Pts** text box. Click the **Create Baseline** button to create the baseline.

End weighted: This baseline detection method first selects data points from the two ends of the original data set. By default, the number of data points selected is approximately one-quarter of the total number of points of the original data set (one-eighth from each end). Adjacent points in this new set of data (from the ends of the original data set) are then averaged with a large window size, resulting in a smoothed data set. Baseline data points are then constructed by interpolation on the set of points common to the smoothed data set and the "end points" data set. The number of baseline points is determined by the **# Pts** text box value.

Entire Data w/o Smooth: Adjacent averaging is performed on the data set with a large window size, resulting in a smoothed data set. Baseline data points are then constructed by interpolation on the set of points common to the smoothed data and the original data set. The number of baseline points is determined by the **# Pts** text box value. This process is extremely sensitive to the distribution of the data. For instance, if the number of points on the baseline is not very large compared to the number of points that fall on the peaks, the baseline will not be well defined. In such cases, you may need to adjust the baseline points using the Modify button.

Entire Data w/ Smooth: The "Entire Data w/o Smooth" algorithm is used, but first the data is smoothed once using the Savitzky-Golay filter.

Positive Peak Algorithm: The peaks are located first, assuming there are only positive ones. The bases of each peak are then connected to form the baseline. This method is fast, but the results may not be very good in many cases.

The User-Defined Equation Radio Button

Select the **User Defined Equation** radio button to create a baseline for the data plot based on a user-defined equation. Type the equation in the associated text box and then click the **Create Baseline** button.

The Use Existing Data Set Radio Button

If the baseline data is available in a separate data set, you can type the name of that data set in the **Dataset** text box and then click the **Create Baseline** button to define the baseline.

The Subtract Button

Click on the **Subtract** button to subtract the calculated or user-specified baseline from the data plot.

The Undo Subtraction Button

Click the **Undo Subtraction** button to undo a baseline subtraction.

The Modify Button

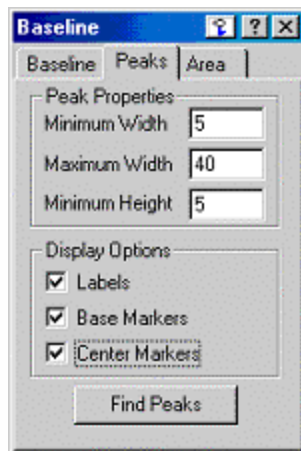
Click the **Modify** button to manually modify the baseline with the Data Reader tool.

1. Click on a baseline point and drag it to a new position.

If the baseline was created automatically or based on a user-defined equation, the modification to the baseline is stored in the worksheet **Base#**.

If the baseline was created from existing data sets, the associated data sets will be modified when you move baseline points.

The Peaks Tab Controls



The Peak Properties Group

The minimum width of the peak is the *percentage*, as specified in the **Minimum Width** text box, of the total number of points in the data range that the peak must have in order to be recognized as a peak. Generally, the smaller the Minimum Width text box value, the more peaks are likely to be found.

The maximum width of the peak is the *percentage*, as specified in the **Maximum Width** text box, of the total number of points in the data range that the peak must not exceed in order to be recognized as a peak.

The minimum height of the peak is the *percentage*, as specified in the **Minimum Height** text box, of the total amplitude of the data in the range, that the peak must have (the amplitude is defined as the difference between the maximum and the minimum of the data). The smaller the Minimum Height text box value, the more peaks are likely to be found.

The Display Options Group

Select the **Labels** check box to label the data plot with the X coordinates of the center of each peak.

Select the **Center Markers** check box to mark the center of the peaks found.

Select the **Base Markers** check box to display markers at the boundaries (bases) of each peak.

The Find Peaks Button

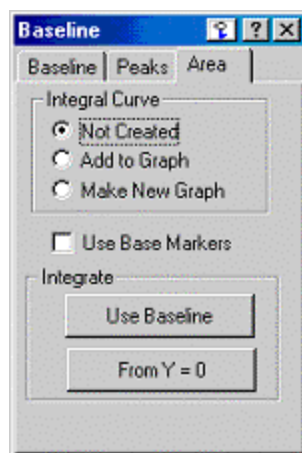
Click this button to find both positive and negative peaks in the current data plot. This button should be clicked after the baseline has been defined (The baseline should be defined prior to performing this operation).

The values under the **Peak Properties** group are used to determine the peak positions in the data plot. A peak is defined as a point where there is a change of sign in the first derivative, which:

- is above a user-defined distance from the baseline.
- is flanked by a neighborhood of at least two points on each side where the first derivative is monotonic.
- The feet of this peak are the points where it meets the baseline.

The peak values are stored in a hidden worksheet name BsPeak#, where # starts from 1 and increments each time a new data plot is processed.

The Area Tab Controls



The Integral Curve Group

Select the **Not Created** radio button to find the area under the curve after clicking either the **Use Baseline** or **From Y=0** buttons.

Select the **Add to Graph** radio button to find the area under the curve and plot the area data in the current layer after clicking either the **Use Baseline** or **From Y=0** buttons.

Rescale the Y axis of the layer to view the area data.

Select the **Make New Graph** radio button to find the area under the curve and plot the area data in a new default graph window after clicking either the **Use Baseline** or **From Y=0** buttons.

The integration results are sent to the Results Log.

- The **Area** column contains the area size under each peak.
- The **Center** column contains the center position of the peak.
- The **Height** column contains the height of the peak.

The Use Base Markers Check Box

Select this check box to include only the region between the base markers when integrating. When this check box is selected, the **Add to Graph** and **Make New Graph** radio buttons are unavailable.

The Integrate Group

Click the **Use Baseline** button to find the area between the active data plot and the baseline. If the **Use Base Markers** check box is selected, find the area between the base markers only.

Click the **From Y=0** button to integrate to find the area between the active data plot and Y=0. If the **Use Peak Markers** check box is selected, find the area between the markers only.

Differentiation and Integration

Differentiating

To calculate the derivative of the active data plot, select **Analysis:Calculus:Differentiate**. Origin calculates the derivative and adds this data to a new **Derivative#** (hidden) worksheet. Origin then opens an instance of the DERIV.OTP graph template and plots the derivative into this window. Any subsequent derivative operation is plotted into this **Deriv** window.

The derivative is taken by averaging the slopes of two adjacent data points:

$$\frac{1}{2} \left(\frac{y_{i+1} - y_i}{x_{i+1} - x_i} + \frac{y_i - y_{i-1}}{x_i - x_{i-1}} \right)$$

Differentiating using Savitzky-Golay Smoothing

To find the first or second order derivatives for the active data plot, select **Analysis:Calculus:Diff/Smooth**. This menu command opens the **Smoothing** dialog box. Specify the **Polynomial Order** (from 1-9), the **Points to the Left**, and the **Points to the Right**, and click **OK**.

If you select a Polynomial Order greater than 1, the **Derivatives On Dataset** dialog box opens. Specify the derivative order and click **OK**. An instance of the DERIV.OTP graph template then opens. The derivative is plotted into this window. The derivative data is saved in a new **Smoothed#** hidden worksheet, where # is the derivative curve number in the project (starting from 1).

The **Diff/Smooth** menu command uses the Savitzky-Golay smoothing method that performs a local polynomial regression around each point. Enough information is thus provided to calculate the derivatives of the data set up to an order equal to the order of the polynomial used (in Origin's case, this order is 2).

This “side-effect” (of the Savitzky-Golay smoothing) is used by the **Diff/Smooth** menu command to find either the first or second derivative of the active data plot. The derivatives thus calculated are the coefficients of the local polynomials that approximate the data plot.

Integrating

To numerically integrate the active data plot from a baseline of zero using the trapezoidal rule, select **Analysis:Calculus:Integrate**. The integral is plotted and the resulting area, peak location, peak height (maximum deflection from the X axis), and peak width are written to the Results Log.

The integrated result is stored in the data set **_integ_area**. Temporary data sets are deleted when the project is printed or saved or are overwritten when another integration is performed. To preserve integration data, the contents of this dataset are saved to a hidden worksheet, following the naming convention *Integraln_columnName*).

To restore the hidden worksheet and manipulate the data:

1. Open **Project Explorer**
2. Browse the window list and locate the grayed-out **Integraln** window.
3. Double-click on the window icon to restore the window.

Note that the creation of this hidden worksheet creates a non-temporary data set which is saved with the .OPJ file.

If you wish to manually copy **_integ_area** to a non-temporary dataset and view the new data set in the worksheet, type the following script in the Script window (replace *MyNewWks_b* with your worksheet and column name):

```
copy -x _integ_area MyNewWks_b (ENTER)
edit MyNewWks_b (ENTER)
```

Note 1: By convention, reversing the limits of integration changes the sign of the integral. When integrating over an interval [a,b], it is presumed that a<b. Therefore, when a>b (i.e. x column values are in descending order), integration yields a negative area.

Note 2: Origin also supports 3D integration. To compute the volume beneath the surface defined by the matrix, select **Matrix:Integrate** when a matrix is active. Origin performs a double integral over X and Y to compute the volume and reports the value in the Script window.

Fast Fourier Transform (FFT)

Origin and the FFT

The first step in Origin's calculation of the FFT is to make the number of data points an integral power of 2. Origin does this by extending the X data set using the existing step values of X until there are 2^N points and setting all the new Y values to zero, or by truncating the length of a data set until there are 2^N points. The changed sample period results in a slight change in resolution, while the same sampling interval yields the same maximum. The algorithm is based on the initial data set size as follows:

Data Size	Excess Power of Two	Action
0 to 511	Any	Always pad to next power of two
512 to 2047	less than 5% over	Truncate - otherwise pad
2048 to 8192	less than 10% over	Truncate - otherwise pad

Data Size	Excess Power of Two	Action
8192 to 16383	less than 20% over	Truncate - otherwise pad
>16383	less than 30% over	Truncate - otherwise pad

For example:

Given	Next Lowest 2^N	Percent Cutoff Point	Action
2252 points	2048	$2048 + .1 * 2048 = 2252.8$	Truncate to 2048
2253 points	2048	$2048 + .1 * 2048 = 2252.8$	Pad to 4096

If you want to use interpolation to first get an exact power of two, then you must first plot the data as a line plot and then use the **Analysis:Interpolate/Extrapolate** menu command to generate an equal-spaced data set of however many 2^N points you need. Use the FFT on the new data set.

The FFT Tool presents a number of options for performing an FFT, including Forward, Backward, Amplitude, Power, Normalization, Shifting and Phase Unwrapping as well as four 'windowing' functions for enhancing resolution. Some of these options only affect the display of data and some affect magnitudes - in particular, use of Windowing options include scaling factors which are not easily removable or reversible. While the Fourier Transform is its own inverse, most practical implementations of the DFT and the FFT include a sign difference in the imaginary part of its results. Origin makes this difference a selectable option.

The Origin FFT calculates the Real, Imaginary, Complex, Phase and Power components. The plots used by the Forward FFT are (by convention) vs. Frequency. The plots used by the Backward FFT are vs. Time. The complex result in the 'r' column is derived from the square root of the sum of the squares of the Real and Imag(inary) columns. The phase angle in the 'Phi' column is derived from the angle whose tangent is Imag/Real with corrections for quadrant based on the phase unwrap option. The Power is derived from the Real^2/N , where N is the number of points.

There is no difference in the worksheets created by selecting either Amplitude or Power. The complex or 'r' column is displayed in plots of Amplitude while the Power column is displayed in plots of Power.

Normalization in a Forward FFT divides the Real results by $N/2$ (both AC and DC components).

Normalization in a Backward FFT divides the Real results by 2, except for the DC component which is left unchanged.

Shifting will change the X scale and adds an additional data point that duplicates the first (completing a natural symmetry). The unshifted results are 0 to a maximum, while the shifted results are between plus and minus a half-maximum.

By Phase wrapping, Origin keeps the phase angle between plus and minus 180 degrees. Unwrapping the phase allows the angle to vary outside those limits based on the sign changes of the real and imaginary columns.

For more information on FFT, go to www.originlab.com and search the OriginLab Knowledge Base on "FFT".

FFT and the NAG Libraries

Origin includes a number of the NAG function libraries, including **c06 - Fourier Transforms**. Reference information is provided on the NAG libraries in the Origin C Reference Help file (**Help:Programming:Origin C Reference**).

When you install Origin, you are given the option to install the NAG PDF files which document the NAG functions. If you clicked **Yes** to install these files, a \NAG PDFs folder is created with a subfolder for each library. If you did not install the PDFs, you can still open them from your installation CD. If you did not install them, you can do so at any time by running the Origin "Add or Remove Files" program.

To help you get started calling NAG functions from Origin C functions, a number of sample Origin projects and associated source files are included in your Origin \SAMPLES\PROGRAMMING subfolders.

Those related to FFT include:

\NAG 2D FFT\

\NAG FFT Convolution\

\NAG FFT Lowpass\

\NAG STFT\

Troubleshooting Problems with FFT

Problem: After selecting **Analysis:FFT**, an Attention box opens displaying the message “Sampling resolution test failed! Please check your data and set the sampling interval in FFT settings.”

Response: This error message displays when the sampling rate (interval between each X or time value) changes. Among its other restrictions, the FFT requires that sampling data be equally spaced. Although the FFT algorithm will operate on data not equally spaced, it will produce incorrect results.

A small change in sampling rate could be due to instrument instability during data collection. This kind of fluctuation will not have a significant effect on the results of the FFT. However a larger change in sampling rate, such as a data spike, will produce incorrect results.

The sampling interval used to perform the FFT is calculated using only the first few cells of X data. If there is a spike in this data range, it can result in the sampling rate being set incorrectly on the FFT tool's Settings tab. If this is the case, type the correct sampling rate value in the Sampling Interval text box on the Settings tab before performing the FFT. This will allow for accurate results to be calculated.

Problem: When I do an FFT of a known SINE wave, I don't get a perfect amplitude peak at my known frequency.

Response: When you look at the result of an FFT, you can think of it as looking at the 'true' FFT through a picket fence. Changing the picket spacing or shifting your viewpoint will give you a slightly different, but equally valid view. The number of points in the original data set and the sample period will have analogous effects on the FFT. To get the ideal situation asked for, the sample would have to represent one (or more) complete periods with exactly 2^n points of data.

Problem: When I do a Backward FFT of my Forward FFT, I don't get my original data.

Response: The settings for Origin 3.x were such that clicking the Inverse FFT button on the FFT Template returned the original data set (plus any padded points). The correct procedure in 4.x through 7.x is as follows:

1. Do the Forward FFT with Normalization and Shift OFF (unchecked).

The Complex result will be plotted along with Phase. You can modify the Real and Imag values in the FFT worksheet to do Frequency Domain Filtering.

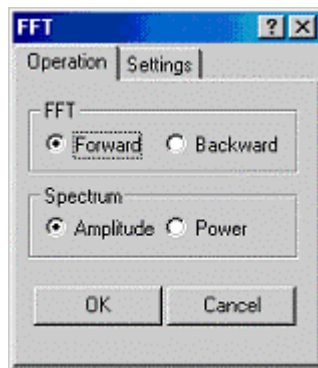
2. Select Real and Imag from the FFT results worksheet and do the Backward FFT with Normalization and Shift OFF (unchecked).
The Complex result will be plotted along with Phase.
3. The Real column of the IFFT results worksheet will be the same as the original data set (plus any padded zero values).

Using the FFT Tool

To perform a fast Fourier transform (FFT) on highlighted data in the worksheet or on the active data plot, select **Analysis:FFT**. This menu command opens the FFT tool that allows you to prepare the data and choose the real, imaginary, and time components for the calculation. Origin's FFT assumes that your independent variable (X data set) is time and that your dependent variable (Y data set) is some sort of amplitude.

FFT Tool Controls

The Operation Tab



The FFT Group

Select the **Forward** radio button to perform a forward FFT calculation when you click **OK**.

Select the **Backward** radio button to perform a backward FFT calculation when you click **OK**.

The Spectrum Group

Select the **Amplitude** radio button to plot amplitude and phase data.

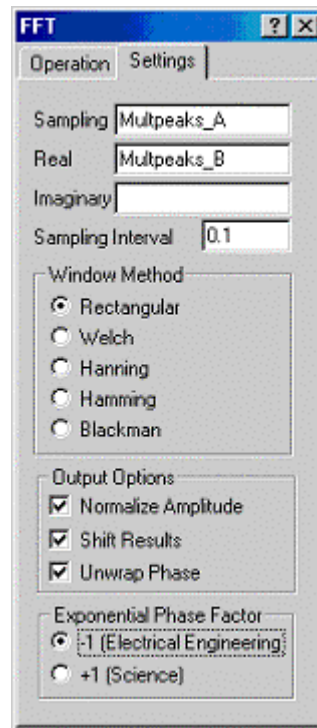
Select the **Power** radio button to plot the power spectrum and phase data.

The OK Button

Click **OK** to perform an FFT. The resulting data is displayed in a new worksheet and graph window.

The Cancel Button

Click **Cancel** to close the tool.

The Settings TabThe Sampling Text Box

Type a data set to be used for time or frequency information. By default, the X data set of the active data plot (or the worksheet's X column) is selected as the sampling data set.

The Real Text Box

Type a data set to be used as the real component for the FFT calculation. By default, the Y data set of the active data plot is selected as the real data set.

The Imaginary Text Box

Type a data set to be used as the imaginary component for the complex FFT calculation. If no data set is specified, a real FFT will be performed.

The Sampling Interval Text Box

Type the time or frequency interval to be used in the FFT calculation. Increase this value if a Time Resolution error occurs.

The Window Method Group

Select the window method to be used in the FFT calculation.

Rectangular Window

$$w[n] = 1 \text{ for } 0 \leq n \leq N-1 \text{ and zero otherwise.}$$

This is the window function used in pre-4.0 versions of Origin.

Using appropriate window functions other than the rectangular window can enhance the spectrum resolution.

Welch Window

$$w[n] = 1 - \left(\frac{n - \frac{1}{2}(N - 1)}{\frac{1}{2}(N + 1)} \right)^2$$

Hanning Window

$$w[n] = \frac{1}{2} \left[1 - \cos \left(\frac{2\pi n}{N - 1} \right) \right]$$

Hamming Window

$$w[n] = 0.54 - 0.46 \cos \left(\frac{2\pi n}{N - 1} \right)$$

Blackman Window

$$w[n] = 0.42 - 0.5 \cos \left(\frac{2\pi n}{N - 1} \right) + 0.08 \cos \left(\frac{4\pi n}{N - 1} \right)$$

The Output Options Group

Select the **Normalize Amplitude** check box to perform amplitude normalization. The effect on the FFT result is to divide the amplitudes of the DC and AC components by $N/2$, where N is the number of data points. This will reveal the true amplitudes in the original data set. This occurs because we know that

$\cos(x) = [\exp(-ix) + \exp(ix)] / 2$. Thus, when a time domain data set is transformed into the frequency domain by FFT, each component splits into two frequencies, a positive one and its negative image. The amplitude of each of these frequencies is $N/2$ times that of its original component.

To calculate the mean of the data set, divide the DC component by 2.

The **Shift Results** check box determines how the transformed data will be presented. If the check box is cleared, the transform is displayed for positive frequencies only, similar to displaying the phase in the range of 0° to 360° . This is in better agreement with the normal definition of DFT. If the check box is selected, the transform is shifted around to be displayed with both positive and negative frequencies centered at zero, similar to displaying the phase in the range of -180° to $+180^\circ$. There is one extra frequency point involved in this presentation. Some symmetrical properties of FFT can be better seen in this form.

Select the **UnWrap Phase** check box to keep the phase unwrapped, to maintain the true phase data. By default, phase data is wrapped so that it is defined in the range of -180° to $+180^\circ$.

The Exponential Phase Factor Group

Select the **Electrical Engineering** or **Science** convention to set the sign of the Exponential Phase factor for the FFT operation.

If you select the **Science** option, the phase factor will be set according to the formulae listed in page 503 of Numerical Recipes in C, 2nd edition.

If you select the **Electrical Engineering** option, the phase factor will be of opposite sign compared with the **Science** option. The two definitions give the same real components, but their imaginary components and the phase angle will have opposite signs.

Discussion of FFT Tool Results

After clicking **OK** on the **Operation** tab of the FFT tool, Origin performs the FFT and appends the results to two new windows: a graph and worksheet window.

The **FFTPlotn** graph window displays the amplitude and phase information for the transformed data. Because Origin's FFT assumes that the independent variable (X data set) is time (in seconds) and that the dependent variable (Y data set) is some sort of amplitude, the X axis for the FFT graph window will be scaled in units of Hz. If your data is not time-series data, you will need to re-label your axis.

The FFT worksheet window contains the frequency data, the real and imaginary parts of the transformed data, the polar form of the transformed data, and the power spectrum data.

The frequency column is obtained from the time data set as follows: If the time separation between successive abscissas is Δt , then the n^{th} frequency datum is:

$$f_n = \frac{n}{N\Delta t}$$

If the time data are given by the row index, then Δt is simply unity.

If there are N input data points, the frequency domain will also have N points with the maximum

frequency, f_{max} equal to $\frac{1}{\Delta t} \left(1 - \frac{1}{N}\right)$ where Δt is the time step between points. If the Shift Results check box on the Settings tab of the FFT tool has been cleared, the unshifted transform

displays from 0 to f_{max} . Otherwise, the shifted transform displays from $-\frac{f_{\text{max}}}{2}$ to $\frac{f_{\text{max}}}{2}$.

Performing a Backward FFT

Origin allows you to apply a backward (or inverse) FFT on the FFT result to transform back the original data set. Thus, you can apply a backward FFT on the Freq(X), Real(Y), and Imag(Y) data sets in the FFT results worksheet. In principle, this should transform the FFT result back to its original data set. However, this claim is valid only for the FFT results when both the **Normalize Amplitude** and **Shift Results** check boxes are *cleared* when first applying FFT to the (original) data set.

Otherwise, if the Normalize Amplitude check box is selected when performing the FFT, the amplitude ratio between AC and DC components will be distorted by a factor of 2. Additionally, if the Shift Results check box is selected when performing the FFT, the FFT results will be in a computationally wrong order and, furthermore, the total number of frequency points is incorrect. Consequently, in this situation the backward FFT will not get the FFT result back to its original data.

FFT Mathematical Descriptions

Discrete Fourier Transform (DFT)

For a data set $x[n]$ with index n in the range $0 \leq n \leq N-1$, ($x[n]$ can be real or complex numbers), the (forward) Discrete Fourier Transform (DFT) is defined to be:

$$X[k] = \sum_{n=0}^{N-1} x[n] \exp(-i2\pi F_k n) \quad 0 \leq n \leq N-1$$

where $F_k = \frac{k}{N}$

Note that DFT transforms N complex numbers $x[n]$ (real numbers are complex numbers with imaginary components having zero values) into N complex numbers $X[k]$. Also note that DFT involves only the data values and their indices. Other variables associated with the data (such as time) are not needed in the calculation. In practice, DFT is often performed on data collected at an equal (time) interval τ . It is easy

to convert the index into “time” $t = n\tau$, and $F_k = \frac{k}{N}$ into “frequency” $f_k = \frac{k}{N\tau}$.

The inverse (backward) Discrete Fourier Transform (DFT) is defined to be:

$$x[n] = \frac{1}{N} \sum_{k=0}^{N-1} X[k] \exp(i2\pi F_k n) \quad 0 \leq k \leq N-1$$

The formulae for forward and inverse DFT presented here follow the phase convention used in Electrical Engineering. It differs from the definition in Numerical Recipes in the sign of the phase factor in the exponent. The FFT definition in Numerical Recipes follows:

$$X[k] = \sum_{n=0}^{N-1} x[n] \exp(i2\pi F_k n) \quad 0 \leq n \leq N-1$$

$$x[n] = \frac{1}{N} \sum_{k=0}^{N-1} X[k] \exp(-i2\pi F_k n) \quad 0 \leq k \leq N-1$$

The two definitions give the same real components, but their imaginary components have the opposite sign. You can select between the Engineering and Science phase conventions in Origin under the Settings tab of the FFT interface.

Parseval's theorem can be used to check the results of DFT:

$$\sum_{n=0}^{N-1} |x[n]|^2 = \frac{1}{N} \sum_{k=0}^{N-1} |X[k]|^2$$

Fast Fourier Transform (FFT)

Every efficient algorithm of DFT can be called an FFT. Origin implements the Danielson-Lanczos method (see references). Danielson and Lanczos showed that if the total number of data points N is an integer power of 2, the DFT of these N numbers can be rewritten as the sum of two DFTs, each of length $N/2$:

$$X[k] = \sum_{j=0}^{N/2-1} x[2j] \exp\left(-i \frac{2\pi kj}{(N/2)}\right) + W^k \sum_{j=0}^{N/2-1} x[2j+1] \exp\left(-i \frac{2\pi kj}{(N/2)}\right)$$

where $W = \exp\left(-i \frac{2\pi}{N}\right)$. We can use the Danielson-Lanczos Lemma recursively, thus reducing the calculation to $\sim N \log_2 N$, compared to $\sim N^2$ required by DFT.

Power Spectrum Estimation Using FFT

The FFT of a set of sampled data is not the true Fourier transform of the process from which the data was obtained. The discrete data is obtained effectively by a window function $w[n]$ which selects a finite-length (N samples) of $x[n]$ from the continuous signal:

sampled data $v[n] = w[n]x[n]$

($w[n] = 0$ for n outside the range $0 \leq n \leq N-1$)

The FFT of the sampled data is:

$$V[k] = \sum_{n=0}^{N-1} w[n]x[n] \exp(-i2\pi F_k n) \quad 0 \leq k \leq N-1$$

An estimate of the power spectrum is:

$$P[k] = \frac{1}{\sum_{n=0}^{N-1} (w[n])^2} |V[k]|^2$$

, which is also called periodogram.

Some of the popular window functions are listed below:

Rectangular Window:

$w[n] = 1$ for $0 \leq n \leq N-1$ and zero otherwise. This is the window function used in pre-4.0 versions of Origin.

Using appropriate window functions other than the rectangular window can enhance the spectrum resolution.

Welch Window:

$$w[n] = 1 - \left(\frac{n - \frac{1}{2}(N-1)}{\frac{1}{2}(N+1)} \right)^2$$

Hanning Window:

$$w[n] = \frac{1}{2} \left[1 - \cos \left(\frac{2\pi n}{N-1} \right) \right]$$

Hamming Window:

$$w[n] = 0.54 - 0.46 \cos \left(\frac{2\pi n}{N-1} \right)$$

Blackman Window:

$$w[n] = 0.42 - 0.5 \cos\left(\frac{2\pi n}{N-1}\right) + 0.08 \cos\left(\frac{4\pi n}{N-1}\right)$$

Correlation using the FFT

To measure the correlation between two columns of data, highlight the desired data (independent of column designation) and select **Analysis:Correlate**. Origin adds two columns to the rightmost position in the worksheet. The left column holds the resultant lag or index variables, and the right column holds the correlation result.

The absolute value of the correlation result will be large when the leftmost data set is exactly shifted to the right or to the left of the second data set by the lag value.

To learn more about correlation, review the FFT CORRELATION.OPJ project located in your Origin \SAMPLES\ANALYSIS\FFT folder.

Convolution using the FFT

The convolution of two data sets is a general process that can be used for various types of data smoothing, signal processing, or edge detection. The leftmost data set, the signal data set, is convolved by the second data set, the response data set. The response data set should meet the following requirements:

- The response data set should consist of an odd number of points and be a representative sample of a symmetric function.
- The number of points, r , in the response data set must be less than half the number of points, s , in the signal data set. (The last r points, and, to a lesser extent, the first r points, of the s points in the result are of no value. Therefore, $2*r$ should be much less than s .)
- The sum of the points in the response curve should be unity in order to retain the amplitude of the original data set. Otherwise the convolution result will be scaled by a factor equal to the sum.

To avoid possible artifacts from the FFT (performed as part of the convolution process), you should pad the signal data with zero values until you have an integral power of two number of points. You will also need to extend your X data accordingly.

To convolve a data set with a response data set, highlight both data sets and select **Analysis:Convolute**. Origin adds two columns to the rightmost position in the worksheet. The left column holds the index variables, and the right column holds the convolution result.

To learn more about convolution, review the FFT CONVOLUTION.OPJ project located in your Origin \SAMPLES\ANALYSIS\FFT folder.

Note: Origin 7 includes a number of the NAG function libraries, including c06 - Fourier Transforms. Reference information is provided on the NAG libraries in the Origin C Reference Help file (**Help:Programming:Origin C Reference**). Furthermore, when you install Origin, you are provided the option to install the NAG PDF files which document the NAG functions. If you clicked Yes to install these files, a \NAG PDFs folder is created with a subfolder for each library. If you did not install the PDFs, they remain accessible on your installation CD. Furthermore, you can install them at a later date by running the Origin "Add or Remove Files" program.

To help you get started calling NAG functions from Origin C functions, a number of sample Origin projects and associated source files are included in your Origin \SAMPLES\PROGRAMMING subfolders. Those related to FFT include:

\NAG 2D FFT\

\NAG FFT Convolution\

\NAG FFT Lowpass\

\NAG STFT\

Deconvolution using the FFT

Deconvolution is a process that can undo the “blurring” obtained after convoluting data. While convolution is the product of the signal and response data sets, deconvolution is achieved by dividing the known convolution by the response data set.

The response data set should meet the following requirements:

- The response data set should consist of an odd number of points and be a representative sample of a symmetric function.
- The number of points, r , in the response data set must be less than half the number of points, s , in the signal data set. (The last r points, and, to a lesser extent, the first r points, of the s points in the result are of no value. Therefore, $2*r$ should be much less than s .)
- The sum of the points in the response curve should be unity in order to retain the amplitude of the original data set.

To avoid possible artifacts from the FFT (performed as part of the deconvolution process), you should pad the signal data with zero values until you have an integral power of two number of points. You will also need to extend your X data accordingly.

To deconvolve a data set with a response data set, highlight both data sets (the convolved data set should be on the left, the response data set on the right) and select **Analysis:Deconvolute**. Origin adds two columns to the rightmost position in the worksheet. The left column holds the index variables, and the right column holds the deconvolution result.

To learn more about deconvolution, review the FFT DECONVOLUTION.OPJ project located in your Origin \SAMPLES\ANALYSIS\FFT folder.

Data Smoothing and Filtering

Smoothing using Savitzky-Golay Filtering

The Savitzky-Golay filter method essentially performs a local polynomial regression to determine the smoothed value for each data point. This method is superior to adjacent averaging because it tends to preserve features of the data such as peak height and width, which are usually ‘washed out’ by adjacent averaging.

To smooth the active data plot using the Savitzky-Golay filter method:

1. Select **Analysis:Smoothing:Savitzky-Golay**.

This menu command opens the **Smoothing** dialog box. The degree of the underlying polynomial has a default value of 2, with an upper limit of 9. This parameter allows you to improve the fitting/differentiation (For an illustration of the effect of this parameter on smoothing, see *Numerical Recipes in C* by Press et. al., Second Edition, Fig. 14.8.2, page 654).

2. To alter this value, select the desired value from the drop-down list.

Origin includes a function to calculate a large number of Savitzky-Golay coefficients, allowing you to have large windows (~ 100 points). Further, you can make the windows asymmetric about a particular data point. For example, the number of points to the left of the point of interest can be different from the number to the right. Make your selection from the associated drop-down lists.

Smoothing using Adjacent Averaging

To smooth the active data plot by averaging adjacent data points:

1. Select **Analysis:Smoothing:Adjacent Averaging**. This menu command opens the **Smoothing** dialog box.
2. Specify a number that controls the degree of smoothing.

If you enter an odd number n , then n points are used to calculate each averaged result.

If you enter an even number m , then $m+1$ points are used to calculate each averaged result.


The smoothed value at index i is the average of the data points in the interval $[i-(n-1)/2, i+(n-1)/2]$, inclusive.

FFT Filter Smoothing

To smooth the active data plot by FFT filtering:

1. Select **Analysis:Smoothing:FFT Filter**.

This menu command opens the **Smoothing** dialog box in which you specify how many data points at a time to be considered by the smoothing routine.

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

The smoothing is accomplished by removing Fourier components with frequencies higher than:

$$\frac{1}{n\Delta t}$$

where n is the number of data points considered at a time, and Δt is the time (or more generally the abscissa) spacing between two adjacent data points.

Note 1: The function used to clip out the high-frequency components is a parabola with its maximum of 1 at zero frequency and falling to zero at the cutoff frequency defined above. The parameters of this parabolic clipping function are determined by the total number of points and the number of points considered at one time. The more points considered at one time, the greater the degree of smoothing. A value of zero for this parameter will leave the data unsmoothed.

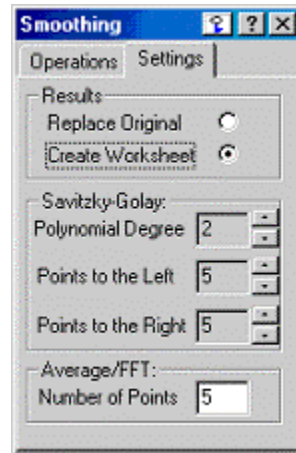
Note 2: The various FFT filtering techniques (Low/High Pass, Band Pass, etc.) are not affected by data masking.

Using the Smoothing Tool

To open the **Smoothing** tool, make the desired data plot active and select **Tools:Smooth**.

The Smoothing Tool Dialog Box Controls

The Settings Tab



The Results Group

Select the **Replace Original** radio button to replace the raw data plot with the smoothed data.

Select the **Create Worksheet** radio button to create a new hidden worksheet containing the smoothed data.

The Savitzky-Golay Group

The degree of the underlying polynomial (**Polynomial Degree**) has a default value of 2, with an upper limit of 9. This parameter allows you to improve the fitting/differentiation. Select the desired value from the associated control. (For an illustration of the effect of this parameter on smoothing, see Numerical Recipes in C by Press et. al., Second Edition, Fig. 14.8.2, page 654.)

Origin includes a function to calculate a large number of Savitzky-Golay coefficients, allowing you to have large windows (~ 100 points). Further, you can make the windows asymmetric about a particular data point. For example, the number of points to the left of the point of interest can be different from the number to the right. Make your selection from the **Points to the Left** (and **Right**) controls.

The Average/FFT Text Box

For adjacent averaging and FFT filter smoothing, specify the number of data points at a time to be considered by the smoothing routine in the associated text box.

The Operations Tab



The Savitzky-Golay Button

Click this button to perform [Savitzky-Golay filter smoothing](#) calculations on the active data plot. The settings on the Settings tab control the degree of smoothing.

The Adjacent Averaging Button

Click this button to smooth the active data plot using [Adjacent Averaging](#). The **Number of Points** text box value (Settings tab) controls the degree of smoothing.

The FFT Filtering Button

Click this button to smooth the active data plot using [FFT Filter Smoothing](#). The **Number of Points** text box value (Settings tab) controls the degree of smoothing.

Digital Filtering

Low and High Pass Filters

To apply a low or high pass filter to the active data plot:

1. Select **Analysis:FFT Filter:Low Pass (High Pass)**.

Both menu commands open the **Frequency Cutoff** dialog box. Origin calculates a default cutoff frequency (Fc) using the equation $F_c = 10 * (1/\text{period})$ where period is the X data set range.

2. Type the desired cutoff frequency in the **Fc** text box.
3. Choose a **Filtered Curve Color**.
4. To display the high pass filtered data with the DC offset stored in F0, select the **Apply F0 Offset** check box (**High Pass** only).
5. Click **Apply** or **OK**.

If you selected **Low Pass**, Origin filters out frequencies above the cutoff frequency.

If you selected **High Pass**, Origin filters out frequencies below the cutoff frequency.

Origin creates a new hidden worksheet containing the X and Y components of the filtered data. Origin also displays the filtered data in the graph window.

To learn more about the low pass filter, review the FFT LOW PASS FILTER.OPJ project located in your Origin \SAMPLES\ANALYSIS\FFT folder.

Note: Origin 7 includes a number of the NAG function libraries, including c06 - Fourier Transforms. Reference information is provided on the NAG libraries in the Origin C Reference Help file (**Help:Programming:Origin C Reference**). Furthermore, when you install Origin, you are provided the option to install the NAG PDF files which document the NAG functions. If you clicked Yes to install these files, a \NAG PDFs folder is created with a subfolder for each library. If you did not install the PDFs, they remain accessible on your installation CD. Furthermore, you can install them at a later date by running the Origin "Add or Remove Files" program.

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\NAG FFT Convolution\

\NAG FFT Lowpass\

\NAG STFT\

Band Pass Filter

To eliminate noise above and below a specified frequency range (band pass filter) in the active data plot:

1. Select **Analysis:FFT Filter:Band Pass**.

This menu command opens the **Frequency Range** dialog box. Origin calculates a default low cutoff frequency (F_L) using the equation $F_L = 10 * (1/\text{period})$ where period is the X data set range. Origin calculates a default high cutoff frequency (F_H) using the equation $F_H = 20 * (1/\text{period})$.

2. Type the desired cutoff frequencies in the **Low** and **High** text boxes.
3. To display the filtered data with the DC offset stored in F0, select the **Apply F0 Offset** check box.
4. Choose a **Filtered Curve Color**.
5. Click **Apply** or **OK**.

Origin filters out frequencies outside of the specified frequency range.

Origin creates a new hidden worksheet containing the X and Y components of the filtered data. Origin also displays the filtered data in the graph window.

Band Block Filter

To eliminate noise within a specified frequency range (band block filter) in the active data plot:

1. Select **Analysis:FFT Filter:Band Block**.

This menu command opens the **Frequency Range** dialog box. Origin calculates a default low cutoff frequency (F_L) using the equation $F_L = 10 * (1/\text{period})$ where period is the X data set range. Origin calculates a default high cutoff frequency (F_H) using the equation $F_H = 20 * (1/\text{period})$.

2. Type the desired cutoff frequencies in the **Low** and **High** text boxes.
3. To display the filtered data with the DC offset stored in F0, select the **Apply F0 Offset** check box.
4. Choose a **Filtered Curve Color**.
5. Click **OK**.

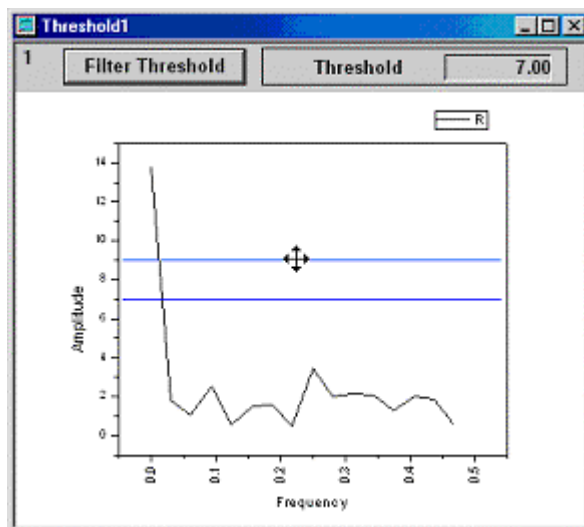
Origin filters out frequencies within the specified frequency range.

Origin creates a new hidden worksheet containing the X and Y components of the filtered data. Origin also displays the filtered data in the graph window.

Threshold Filter

To eliminate noise corresponding to frequency components that are below a specified threshold level in the active data plot:

1. Select **Analysis:FFT Filter:Threshold**. This menu command first performs a forward FFT on the active data plot, and displays the frequency component spectrum with a moveable threshold level line.
2. Drag the line to the desired level, or type an amplitude value for the threshold directly in the **Threshold** text box.



3. Click the **Filter Threshold** button to filter out all frequency components below the set threshold level.

Additionally, an inverse FFT is performed on the filtered frequency spectrum to yield a new hidden worksheet containing the original data with the noise removed.

To learn more about the threshold filter, review the FFT THRESHOLD FILTER.OPJ project located in your Origin \SAMPLES\ANALYSIS\FFT folder.


Sharing your Origin Files

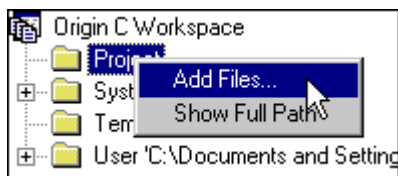
Sharing Origin Project Support Files

Attaching and Retrieving Files

Use **Code Builder** to attach or retrieve files stored with the Origin project file.

To attach files to the OPJ:

1. Click the **Code Builder**  button on the Standard toolbar.
2. Right-click on the **Project** subfolder in the Origin C Workspace tree and choose **Add Files**.



3. Browse to and select the file(s) that you want to attach to the OPJ file (Note that you can also drag-and-drop files from the **User** and **Temp** folders to the **Project** folder).
4. When you save the Origin project file, all files in the **Project** folder are appended and saved inside the OPJ. The Project folder tracks with the OPJ; the contents of this folder do not change when you change your workspace in Code Builder.

When you open an OPJ file to which files have been attached, support files are extracted and stored in a temporary subfolder. To show the path to that subfolder:

1. Right-click on the **Project** folder in Origin C Workspace tree, and select **Show Full Path**.

The attached files can be opened by double-clicking on the file name.

- If the file type is recognized by Code Builder (Origin C and OGS files are specially handled), these files are opened in new windows in the Code Builder Multiple Document Interface (MDI).
- If the file type is *not* recognized by Code Builder, Origin passes the file to the Windows OS for opening. For instance, if a Microsoft Word file were attached and you were to double-click on this file, the file would open in the Microsoft Word application.

Alternately, you could navigate to the Temporary subfolder and launch the file through Windows Explorer. Note that when the project is closed, this subfolder is removed from the system.

Special Handling of Origin C and OGS files

Special handling of OC and OGS files makes it possible to attach custom code to OPJ files and create custom solutions that are easily delivered to other Origin users.

Origin C files that are attached to the project are compiled and loaded when the project to which they are attached is opened. All functions defined in the OC files are accessible to the user from the Origin interface, upon project opening.

With OGS files, you can access script sections in the attached OPJ from the interface when the project is open. For example, if you had attached a file named `MyScripts.OGS`, once the OPJ file was opened, you could issue this command from the interface:

```
Run.section(MyScripts, MySection);
```

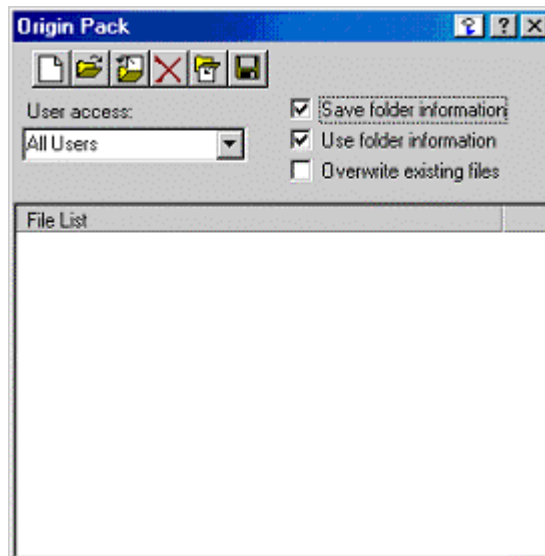
Origin will look to see whether there is a file called `MyScripts.OGS` that is attached to the open OPJ, then will look to see if `MySection` exists within the OGS file. If found, this section is run. If *no* such attached file is found, Origin searches your user-files area, and then finally in the EXE path for the named OGS file.

Sharing Your Custom Tools

Packing Files

To open the Origin Pack dialog box:

1. Select **Tools:Pack/Unpack OPK Files** from the Origin menu. This command opens the **Origin Pack** dialog box.



To create a new packed file:

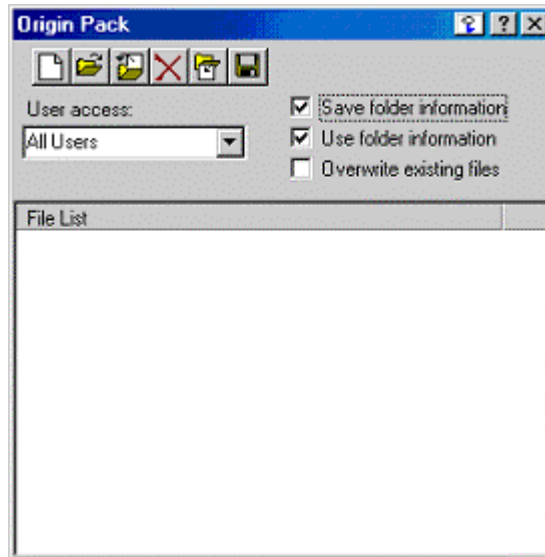
2. Click the **Add** button to open the **Origin Pack Files** dialog box.
3. Add your files in this dialog box. When done, click **OK**.
4. To ensure that the files are packed following the original folder structure, select the **Save Folder Information** check box in the **Origin Pack** dialog box.
5. To restrict the type of Origin user who can open your packed file, make a selection from the **User Access** drop-down list.
6. To create the packed file, click the **Pack** button.

Note: The packing of button groups requires that all supporting files be in the Origin folder or in a subfolder of the Origin folder.

Un-packing Files

To unpack a file:

1. Select **Tools:Pack/Unpack OPK Files** to re-open the **Origin Pack** dialog box.



2. Click the **Open** button, then select the desired .OPK file from the **Origin Pack Files** dialog box.
3. Click **Open**.

To extract files:

4. To maintain the file folder structure of the packed files, select the **Use Folder Information** check box before extracting the files.
5. Click the **Extract** button. (*You cannot exclude files from the unpacking process. All files in the .OPK file will be extracted to the appropriate folder. The file list is used for viewing files in the .OPK file and for packing files to a .OPK file. The Delete button has no effect on the files that will be unpacked.*)

The Drag and Drop OPK Installation Method

You can also drag a .OPK file from Windows Explorer into your running Origin program window. Alternatively, you can drag the file onto the Origin taskbar button *without releasing the mouse button*. After a few seconds, the Origin program window will become active and you can then drag the file into the program window. When you use the drag-and-drop method, Origin uses your current "Use Folder Information" setting to determine if the folder structure of the packed files is maintained.

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Interfacing with Other Applications

Exchanging Data Using the Clipboard

Using the Clipboard to Exchange Data

To copy data between or within a worksheet (or matrix):

1. Select your data.
2. Select **Edit:Copy**.

If you copied a single value to the Clipboard, click on the destination cell and select **Edit:Paste**. If you copied a range of values to the Clipboard, select the cell that is to be the upper-left corner of the range, then select **Edit:Paste**.

To transpose the data when pasting into the destination cells (worksheet only):

1. Select the cell that is to be the upper-left corner of the range of pasted data.
2. Select **Edit:Paste Transpose**. If necessary, Origin adds columns to the worksheet to hold the transposed data.

To learn more about exchanging data using the Clipboard, see *Exchanging Worksheet Data Using the Clipboard*.

Pasting Graphics from the Clipboard

Graphic elements that are copied to the Clipboard from another Windows application can be pasted into an Origin window. To paste a graphic, click at the desired location and select **Edit:Paste** or press CTRL+V, or right-click at the desired location and select **Paste** from the shortcut menu.

Once a graphic element is copied into an Origin window, it becomes an object. The object is selected, moved, and resized like any Origin object. To edit the object, double-click on the object to open the Object Properties dialog box. When editing a pasted object, this dialog box includes an Image tab. You can add a background from this tab. For more information on this dialog box, see *Editing Objects* on page 402.

Exporting ASCII Data

Exporting Worksheet Data

Worksheet data can be exported to another application by:

- Copying the data to the Clipboard.
- By creating an export file.

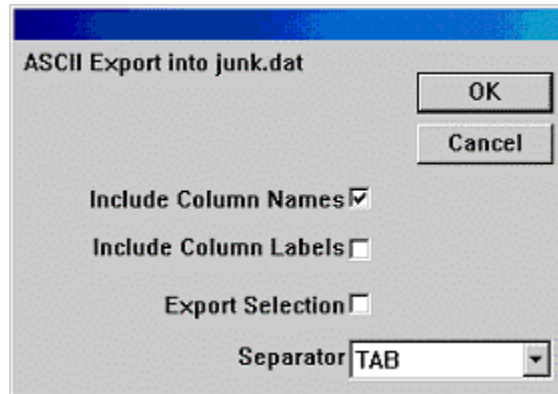
To export data from the worksheet:

1. With the worksheet active, select **File:Export ASCII** from the Origin menu.

This menu command opens the **Export ASCII** dialog box. The worksheet name displays in the **File Name** text box. You can type a new name for the file and choose a new destination folder.

After clicking **Save**, Origin opens the **ASCII Export into File** dialog box, allowing you to control the export options.

ASCII Export Into File Dialog Box Controls



The **Include Column Names** Check Box

When this check box is selected, the column names are copied to the first line of the ASCII file, followed by <CR>, and then the data. The separator selected from the **Separator** drop-down list is used to separate the column names and data.

The **Include Column Labels** Check Box

When this check box is selected (and the **Include Column Names** check box is selected), the column labels are copied to the second line of the ASCII file, followed by <CR>, and then the data. If the **Include Column Names** check box is *not* selected, then the column labels are copied to the first line of the ASCII data file.

The separator selected from the **Separator** drop-down list is used to separate the column labels and data.

The **Export Selection** Check Box

If you want to export a section of the worksheet data, highlight the desired section of data before selecting **File:Export ASCII**. If a section of worksheet data is selected, the **Export Selection** check box will be selected by default. Do not clear the check box unless you want to export the *entire* contents of the worksheet.

If you select **Edit:Set As Begin** and **Edit:Set As End** to set the worksheet range, the Export Selection check box will not be selected. Only the displayed worksheet range exports.

The **Separator** Drop-down List

Select the desired separator (or delimiter) from the **Separator** drop-down list for the data and column names/labels (if the **Include Column Names/Labels** check boxes are selected).

To export a *portion* of the worksheet data:

If you want to save a range of worksheet data to an ASCII file, do *one* of the following *before* selecting **File:Export ASCII**.

- Highlight the desired range of worksheet data.
- Delete the rows and columns of data that you do not want to export using the **Edit:Delete** menu command. This results in a permanent alteration of your worksheet.
- Change the display range of the worksheet before exporting the data. Use the **Edit:Set as Begin** and **Edit:Set as End** menu commands to establish the display range for a column or range of columns. After exporting the desired data range, return the worksheet to the full display range by selecting **Edit:Reset to Full Range** (for more information, see *Setting the Worksheet Display Range* on page 465).

Note: The settings in the **ASCII Export Into** dialog box can be saved with the worksheet template.

A Note on Significant Figures in the Worksheet

When you enter a numeric value in a worksheet cell, Origin may round off the displayed value depending on the numeric display settings in

- the **Worksheet Column Format** dialog box.
- the settings on the **Numeric Format** tab of the **Options** dialog box.

Origin uses the entered value in calculations. *However, only the rounded off value is exported to a file or copied to the Clipboard.*

Exporting Matrix Data

Matrix data can be exported to another application by:

- Copying the data to the Clipboard.
- By creating an export file.

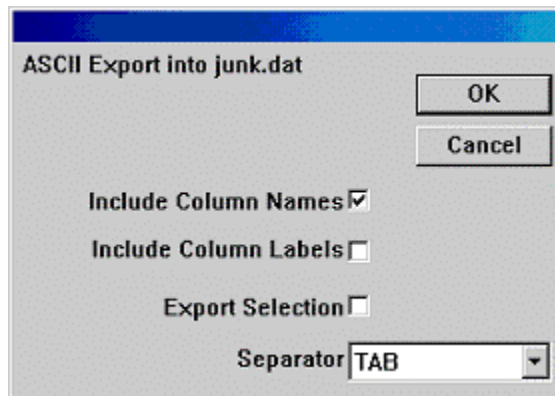
To export data from the matrix:

1. With the matrix active, select **File:Export ASCII** from the Origin menu.

This menu command opens the **Export ASCII** dialog box. The matrix name displays in the **File Name** text box. You can type a new name for the file and choose a new destination folder.

After clicking **Save**, Origin opens the **ASCII Export into File** dialog box, allowing you to control the export options.

ASCII Export Into File Dialog Box Controls



The **Include Column Names** Check Box

When this check box is selected, the column names are copied to the first line of the ASCII file, followed by <CR>, and then the data. The separator selected from the **Separator** drop-down list is used to separate the column names and data.

The **Include Column Labels** Check Box

When this check box is selected (and the **Include Column Names** check box is selected), the column labels are copied to the second line of the ASCII file, followed by <CR>, and then the data. If the **Include Column Names** check box is *not* selected, then the column labels are copied to the first line of the ASCII data file.

The separator selected from the **Separator** drop-down list is used to separate the column labels and data.

The **Export Selection** Check Box

If you want to export a section of the worksheet data, highlight the desired section of data before selecting **File:ExportASCII**. If a section of worksheet data is selected, the **Export Selection** check box will be selected by default. Do not clear the check box unless you want to export the *entire* contents of the worksheet.

If you select **Edit:Set As Begin** and **Edit:Set As End** to set the worksheet range, the Export Selection check box will not be selected. Only the displayed worksheet range exports.

The **Separator** Drop-down List

Select the desired separator (or delimiter) from the **Separator** drop-down list for the data and column names/labels (if the **Include Column Names/Labels** check boxes are selected).

To export a *portion* of the matrix data:

If you want to save a range of matrix data to an ASCII file, do *one* of the following *before* selecting **File:Export ASCII**.

- Highlight the desired range of worksheet data.
- Delete the rows and columns of data that you do not want to export using the **Edit>Delete** menu command. This results in a permanent alteration of your matrix.

To export an image from the matrix.

See *Exporting an Image* on page 122.

Note 1: The settings in the **ASCII Export Into** dialog box can be saved with the matrix template.

Note 2: See the note on exporting significant figures at the bottom of the topic *Exporting Worksheet Data* on page 621.

Sharing Your Graph with Another Application

Should I Insert My Graph or Create a Link to My Graph?

There are two methods of sharing Origin objects with OLE-compliant applications: *inserting* your graph or *creating a link* to your graph. The two are distinguished primarily by the storage location of the graph's supporting data.

- When you *insert* your graph into another application, the data are stored in the *destination* application, not in Origin.
- When you *create a link* to your graph in another application, the data are stored *in the Origin file*, not the destination application. The destination application saves a link to the Origin file, and displays an image of the linked graph. (Note that the destination application is the **OLE container** application).

To...	Do this...
Minimize the destination document file size.	Link your graph to the destination application file.
Display your graph in multiple destination documents; changes made to the source graph will be reflected in all documents.	Link your graph to the destination application file.
Create a single, self-contained destination document that contains information on your graph.	Insert your graph into the destination application file.

Controlling the Size of your Linked or Inserted Graph

Control the size of an inserted or linked image using the settings on the Page tab of the Options dialog box (**Tools:Options**). For more information, see *Setting Your Preferences, the Page Tab* on page 658.

Inserting Your Graph into Another Application

Origin provides three methods to insert your graph into another application.

- Paste your graph into another application using the Clipboard.

The graph need not be saved to a graph window file or a project file.

To insert the page of the active graph window as an object into another application:

1. In Origin, select **Edit:Copy Page**.
2. In the destination application (such as Microsoft® Word), select **Edit:Paste Special**. In Word, this menu command opens the **Paste Special** dialog box.
3. Select **Origin Graph Object** from the **As** list box.
4. Select the **Paste** radio button.
5. Click **OK**.

Your graph displays as an object in the destination application.

To control the default size of the object in the destination application, edit the **Copy Page** group on the **Page** tab of the **Options** dialog box (**Tools:Options**).

Note: Pressing CTRL+C = selecting **Edit:Copy Page** (Origin); CTRL+V = **Edit:Paste** (destination application).

- Insert your graph window file (*.OGG) into another application.

The graph must already be *saved to a graph window file*.

To insert the page of an existing *.OGG graph window file as an object into another application:

1. In the destination application (such as Word), select **Insert:Object**. In Word, this menu command opens the **Object** dialog box.
2. Select the **Create from File** tab.
3. Click **Browse**. This action opens the **Browse** dialog box.
4. Select your *.OGG file.
5. Click **OK**.
6. In the **Object** dialog box, make sure the **Link to File** check box is *cleared*.
7. Click **OK**.

Your graph displays as an object in the destination application.

- Create (and insert) a new graph in another application.

To create and insert the page of a graph window as an object in another application:

1. In the destination application (such as Word), select **Insert:Object**. In Word, this menu command opens the **Object** dialog box.
2. Select the **Create New** tab.
3. Select **Origin Graph** from the **Object Type** list box.
4. Click **OK**. This action creates a new instance of Origin displaying a graph in a **Document_n** window.
5. Make this new instance of Origin the active application.
6. Create your graph (in the new program instance).
7. With your graph window active, select **File:Update Document_n**.
8. Select **File:Exit and Return to Document_n**. This menu command closes the new instance of Origin and returns activity to the destination application (in this example, Word).

Editing an Inserted Graph in the Destination Application

Once an Origin object is inserted into a destination application, it is editable using Origin's tools. In general, to edit the inserted object in Origin:

1. Double-click the inserted graph.
2. This opens an instance of Origin; the graph window displays in the workspace and is ready for editing.
3. Make changes to the graph.

To update the inserted object:

1. Select **File:Update *DestinationApplication***.

To close the instance of Origin and return to the destination application:

1. Select **File:Exit and Return to *DestinationApplication***.

Using In-place Activation to Edit the Inserted Graph

As an alternative, Origin objects inserted into a destination application can be edited *within the window of the destination application*. This editing method works by "in-place activation".

To enable in-place activation:

1. From the Origin menu, select **Tools:Options**, and choose the **Graph** tab.
2. Select the **Enable OLE In-place Activation** check box.
3. Click **OK** to close the dialog box (You are prompted to "Save as Origin's startup options?").
4. You may close Origin.

To edit the graph using in-place activation:

1. Double-click on the inserted (not linked) Origin graph in the destination application. The Origin graph is activated "in-place" and is ready for editing.

Note: In general, in-place activation is not the recommended method for editing inserted Origin graphs; you do not have access to many useful Origin features - for instance, the worksheet windows that may contain data plotted in the graph.

Creating a Link to Your Graph in Another Application

Two methods exist for creating a link to your graph in another application:

- Create a link to your graph that is part of a saved Origin project (*.OPJ) file.

To create a link to a graph in a *saved* Origin project file:

1. Open the project that includes your graph window.
2. With the graph window active, select **Edit:Copy Page**.
3. In the destination application (such as Word), select **Edit:Paste Special**. In Word, this menu command opens the **Paste Special** dialog box.
4. Select **Origin Graph Object** (or **Picture**) from the **As** list box.
5. Select the **Paste Link** radio button.
6. Click **OK**.

Your graph displays as an object in the destination application.

To control the default size of the object in the destination application, edit the **Copy Page** group on the **Page** tab of the **Options** dialog box (**Tools:Options**).

- Create a link to your graph that is saved as a graph window (*.OGG) file.

To create a link to a graph in a saved Origin graph window file:

1. In the destination application (such as Word), select **Insert:Object**. In Word, this menu command opens the Object dialog box.

2. Select the **Create from File** tab.
3. Click **Browse**. This action opens the Browse dialog box.
4. Select the desired *.OGG file.
5. Click **OK**.
6. In the **Object** dialog box, select the **Link to File** check box.
7. Click **OK**.

Your graph displays as an object in the destination application.

Editing a Linked Graph in the Destination Application

In a general sense, you initiate the editing process by:

1. Opening the Origin project or graph window file that contains the source for the linked object.
2. Edit the graph using Origin's tools.

Alternatively, you can:

1. Double-click on the linked object in the destination application. This action opens an instance of Origin displaying the linked graph in a graph window.
2. Make changes to the graph in this instance of Origin.

After making changes to the graph in Origin:

3. Select **Edit:Update Client** from the Origin menu bar.

or

3. Redirect window activity to the destination application.
4. Update the link within the destination application. For instructions on updating the link, consult the destination application's documentation.

Inserting Origin Data Plot Symbols and Lines in Other Applications

Origin installs a True Type font set called Origin into the Windows \FONTS folder. This font set includes the data plot symbols available from the symbol gallery on the Symbol tab of the Plot Details dialog box, and the line styles available from the Style drop-down list on the Line tab of the Plot Details dialog box.

Thus, you can now include Origin's symbols and line styles in other applications. For example, when you select **Insert:Symbol** in Microsoft Word, Origin is now available from the Font drop-down list.

LabVIEW

Origin's Building-Block VIs

The table below provides a list of Origin's building-block VIs. For more detailed information on each VI, such as the wiring diagram and nodes, please refer to the "Origin VIs for LabVIEW" section of the Programming Help file (**Help:Programming**).

Once you insert a building-block VI into your LabVIEW block diagram, obtain more information on the VI by...

1. selecting **Help | Show Context Help** from the LabVIEW help menu, then
2. clicking on the inserted VI.

Name	Icon	Remarks
OAOpenCommunication.VI		Open communication with Origin.
OACloseCommunication.VI		Close communication with Origin.
OAShowHide.VI		Show/Hide Origin.
OAExit.VI		Exit Origin.
OALoadProject.VI		Open an existing Origin project.
OASaveProject.VI		Save the current Origin project.
OACopyPage.VI		Copy an Origin Page to the Clipboard.
OACreate.VI		Create an Origin Page.
OADestroy.VI		Destroy an Origin Page.
OAExecute.VI		Send a LabTalk script command to Origin.
OAPutWorksheet.VI		Put data into an Origin worksheet.
OAPutMatrix.VI		Put data into an Origin matrix.
OAGetWorksheet.VI		Get data from an Origin worksheet.
OAGetMatrix.VI		Get data from an Origin matrix.
OARun.VI		Instruct Origin to finish current auto-update calculations before proceeding.
OAResetProject.VI		Clear all worksheets and matrices in the current Origin project.
OABeginSession.VI		Reserve the current Origin session for exclusive use – other clients will not have access to Origin.
OAEndSession.VI		Release the current Origin session from exclusive use – allow other clients access to Origin.
OAGetIsModified.VI		Get the IsModified property for the current Origin project – this property indicates if project has been modified or not.

Name	Icon	Remarks
OASetIsModified.VI		Set the IsModified property for the current Origin project – determines if the project needs saving or not.
OAGetLTStr.VI		Get the value of the LabTalk string variable.
OASetLTStr.VI		Set the value of the LabTalk string variable.
OAGetLTVar.VI		Get the value of the LabTalk numeric variable.
OASetLTVar.VI		Set the value of the LabTalk numeric variable.
OAGetPageString.VI		Get the textual properties of the specified Origin page (such as a label on a worksheet page).
OASetPageString.VI		Set the textual properties of the specified Origin page (such as a label on a worksheet page).
OA2DArrayToCluster.VI		Convert the 2D array from GetWorksheet or GetMatrix VIs to a cluster.
OAVariant2DToArrayOrCluster.VI		Convert the variant output of GetMatrix VI to a 2D array or cluster.
SampleDataNoise.VI		Create a sample xy array with noise data. This is <i>not</i> an Origin VI. It is provided for testing purposes only.

Tutorials: Using Origin's Building-Block VIs

The next three tutorials walk the user through the process of creating custom LabVIEW VIs using the building-block VIs provided with your Origin software. It is assumed that the building-block VIs have been added to the \user.lib folder of LabVIEW so that they are visible from the LabVIEW **Functions** palette. For more information, please refer to the previous section.

The LabVIEW VI files used in the following three tutorials can be found in the **Samples\Automation Server\LabVIEW** subfolder of the Origin program folder. You can open and run the tutorial VIs directly from that location. Detailed steps on creating the custom VIs are provided in the following tutorials:

Tutorial 1 – Sending Data from LabVIEW to an Origin Worksheet

In this tutorial, you will create a VI to send data from LabVIEW to an Origin worksheet named Data1.

Run Origin. If Origin is already running, start a fresh project. Make sure that there is a worksheet named **Data1** in the Origin project.

1. Run LabVIEW and start a new VI.
2. Activate the **Block Diagram** window and right-click inside the window.
3. From the **Functions** palette, choose **User Libraries**, then **paletteMenu**.
4. Choose OAOpenCommunication VI and place it in the window.



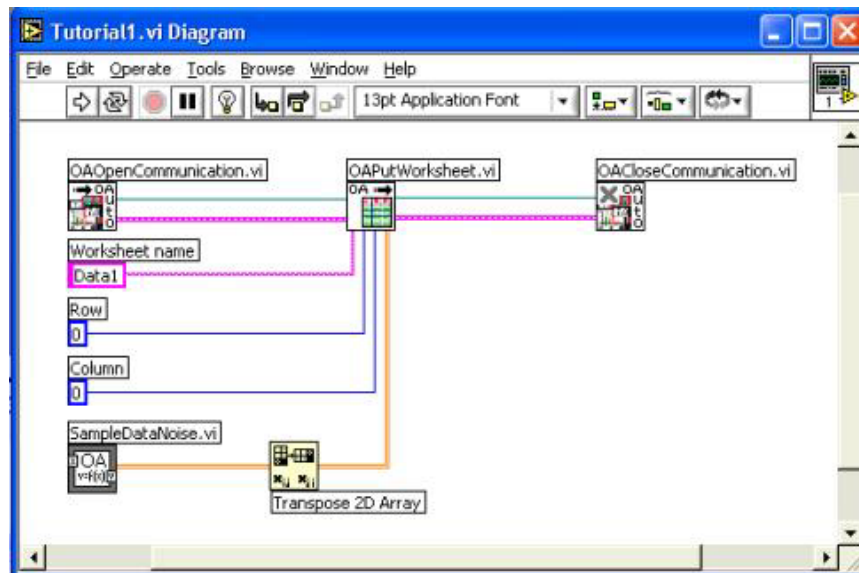
5. Right-click in the window again, and select OAPutWorksheet VI from the same palette as in the previous step.



6. Wire the **Origin.IOApplication** and **Error IO** connectors to the two VIs. Make sure to choose output side connectors for the **OAPOpenCommunication VI** and input side connectors for the **OAPutWorksheet VI**.
7. Add a string constant and assign to it the string **Data1**.
8. Add two numeric constants and set both to 0.
9. Wire the string constant to the **name** connector and the two numeric constants to the **r1** and **c1** connectors of OAPutWorksheet VI (**Hint:** You can click on any Origin VI you place in the window, then go to the Help menu and select **Show Context Help**. This will open the contextual help window with specifics on the connectors to the VI).
10. Right-click in the window, then select the Origin palette (as in step 4), and add the SampleDataNoise.VI (This VI simply uses a formula to create a 2 x n array of x and y values, where y is some noise data).



11. Add a **Transpose 2D Array VI** and wire the **2D array** connector to the output connector of the **SampleDataNoise VI**.
12. Wire the **transposed array** connector of the Transpose 2D Array VI to the **data** connector of the **OAPutWorksheet VI**.
13. Add an **OACloseCommunications VI** from the Origin VI palette and wire the **Origin.IOApplication** and **Error IO** connectors to the corresponding connectors of the **OAPutworksheet VI**. Again, take note of the difference between output and input connectors.
14. When the wiring is complete, your Block Diagram window should look like [this](#):



15. Click the **Run** button to send the data to Origin. You should see the data in the **Data1** worksheet. Try changing the **Row** and **Column** number controls to place data in a different location in the worksheet.

16. Save this VI to disk. We will modify this VI in the next tutorial.

Tutorial 2 – Saving an Origin Project from LabVIEW

In this tutorial, we will launch Origin in hidden mode from LabVIEW, then place some data into an Origin worksheet and save the Origin project.

Close all instances of Origin.

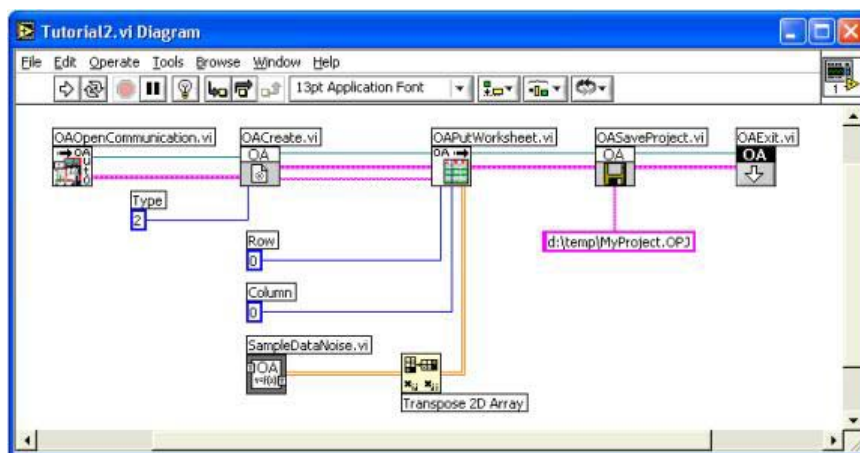
1. Run LabVIEW and open the VI that you saved in step 17 of Tutorial 1.
2. Right-click on **OACloseCommunication VI** and replace it with **OASaveProject VI**.
3. Add a string constant, give the string the value of **D:\temp\MyProject.OPJ** and wire it to the **path** connector of **OASaveProject VI**.
4. Add an **OAEExit VI** and wire the **Origin.IOApplication** and the **Error IO** connectors to the corresponding connectors of **OASaveProject VI**.



5. Delete the wires between **OAOpenCommunication** and **OAPutWorksheet VIs**.
6. Insert an **OACreate VI** between **OAOpenCommunication** and **OAPutWorksheet VIs** and rewire its *input* connectors to **OAOpenCommunication VI** and its *output* connectors to the **OAPutWorksheet VI**.



7. Delete the string constant and the associated wires.
8. Rewire the **name** connector of the **OAPutWorksheet VI** to the **New Name** connector of the **OACreate VI**.
9. Add a numeric constant, set the value to **2** and wire it to the **type** connector of the **OACreate VI**.
10. When the wiring is complete, your Block Diagram window should look like [this](#):



11. If the specified folder **D:\Temp** does not exist, then create one or change the path in the VI to that of an existing folder.

12. Click the **Run** button to run this VI. You should find an Origin project file **MyProject.OPJ** in your **D:\Temp** folder (or other folder that you specified).
13. Open **MyProject.OPJ**. You should find data in the **Data1** worksheet.

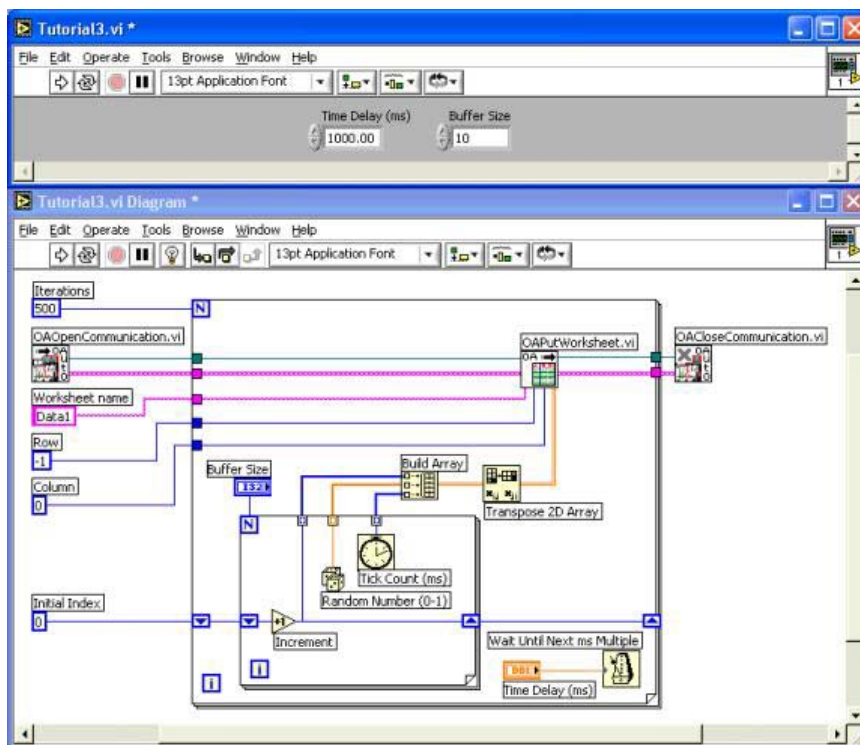
Tutorial 3 – Appending Data to an Origin Worksheet and Plotting in Real-Time

In this tutorial, we will set up VI to continuously append data to an Origin worksheet and plot the 2D line graph in real time.

Launch Origin. If Origin is already running, start a fresh project. Make sure that there is a worksheet named **Data1** in the project.

1. From the menu, select **Column:Add New Columns** to add one column to the Data1 worksheet.
2. Select the first Y column.
3. From the menu, select **Plot:Line** to set up a 2D Line Graph which "plots" the currently empty Y column.
4. Double-click on the X axis of the empty graph to open the **Axis** dialog box. Select the **Scale** tab.
5. Select **Auto** from the **Rescale** drop-down list.
6. Select the **Vertical** icon from the **Selection** list box. Repeat **step 6** and click **OK**.
7. Select the *second* Y column and repeat **steps 4** through **7**.
8. Run LabVIEW and open the VI that you saved in **step 17** of Tutorial 1. Delete the SampleDataNoise VI and the associated wires.
9. Change the value of the constant labeled as **Row** into **-1**, to allow data to be appended.
10. Place a **For Loop** in the Block Diagram and make sure that only **OAPutWorksheet** and **Transpose 2D Array** VIs are placed inside the For Loop and all other VIs are placed *outside*. If there are broken wires, right-click on the corresponding tunnels at the For Loop border and select **Disable Indexing** from the shortcut menu.
11. Place a **Build Array** VI inside the For Loop. Right-click the **element** connector and select **Add Input** to add an element connector to the **Build Array** VI. Repeat to add one more element connector.
12. Place a **Wait Until Next ms Multiple** VI inside the For Loop.
13. Activate the **Front Panel** window and place two **Digital Control** VIs in the window and rename them **Time Delay (ms)** and **Buffer Size**, respectively. Set the **Time Delay (ms) Control** to **1000** and the **Buffer Size Control** to **10**.
14. Activate the Block Diagram window and move the two controls to the inside of the For Loop. Wire the **Time Delay (ms) Digital Control** to the **millisecond multiple** connector of the **Wait Until Next ms Multiple** VI.
15. Inside the For Loop, place a *second* For Loop and wire its **count terminal (N)** to the **Buffer Size** digital control. Make sure that no existing VIs are included in the second For Loop.
16. Inside the second For Loop, place an **Increment** VI, a **Random Number (0-1)** VI, and a **Tick Count (ms)** VI.
17. Wire the first, second and third **element** connector of the **Build Array** VI to the **x+1** connector of the **Increment** VI, the connector of the **Random Number (0-1)** VI, and the connector of the **Tick Count (ms)** VI, respectively.
18. Wire the **appended array** connector of the **Build Array** VI to the **2D array** connector of the **Transpose 2D array** VI.

19. Right-click the left or right border of the first For Loop and choose **Add Shift Register**. Repeat the procedure on the *second* For Loop.
20. Add a numeric constant to the outside of the first For Loop and set its value to **0**. Wire it to the Shift Register at the left border of the first For Loop, to the Shift Register at the left border of the second For Loop, then the **x** connector of the **Increment VI**.
21. Wire the **x+1** connector of the **Increment VI** to the Shift Register at the right border of the second For Loop, then to the Shift Register at the right border of the first For Loop.
22. When the wiring is complete, your Front Panel and Block Diagram windows should look like [this](#):



23. Click the **Run** button to append data to the Origin Worksheet.

You should see that the data in the Data1 worksheet increases by 10 rows at a time. The first Y column contains the random numbers and the second Y column contains the tick count at each iteration. In addition, you should see the 2D Line Graphs plot the appended data in real-time. You can change the **Time Delay** value to **100 ms** and see the updating frequency increase. You can also change the **Buffer Size** value to **1** and see that the append rate changes to 1 row at a time.

MATLAB Console

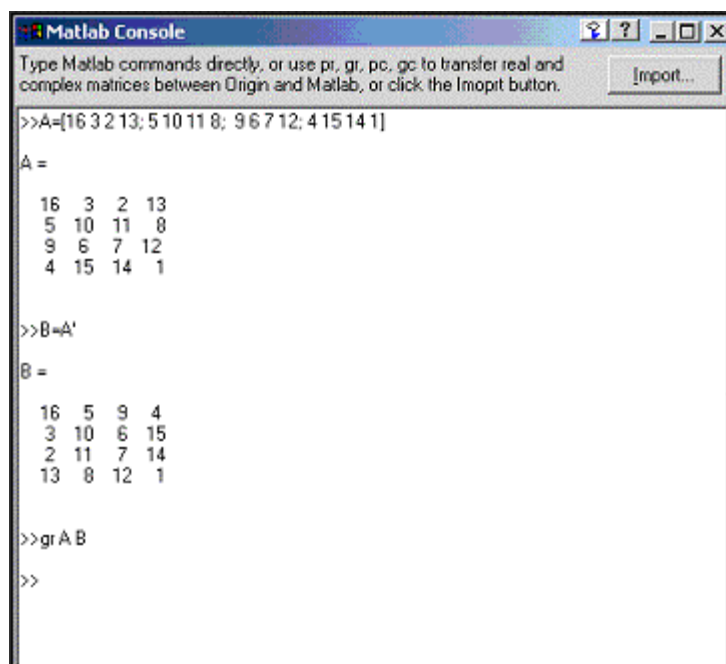
This feature allows Origin users to issue MATLAB commands from within the Origin environment, transfer data between the two applications, and open MATLAB workspace files to import data into Origin.

These features require that both Origin and MATLAB to be installed on the same computer.

To start the MATLAB console application:

1. From the Origin menu, select **Tools:MATLAB Console**.

This will launch a new instance of the MATLAB application. A MATLAB Command Window opens in the Origin workspace.



A set of new commands are available to the user in this Console window, which allow easy transfer of real and complex 2-D matrices back and forth from MATLAB.

Command	Application
gr <i>matName1</i> <i>matName2</i> ...	Get real matrices named <i>matName1</i> , <i>matName2</i> , etc. from MATLAB. New matrix windows of the same name are created in Origin. Existing windows of the same name are overwritten.
gc <i>matName1</i> <i>matName2</i> ...	Get complex matrices named <i>matName1</i> , <i>matName2</i> , etc. from MATLAB. New matrix windows, for real and complex components, are created in Origin. Existing windows of the same name are overwritten.
pr <i>matName1</i> <i>matName2</i> ...	Put real matrices named <i>matName1</i> , <i>matName2</i> etc. from Origin to MATLAB. Existing windows of the same name are overwritten.
pc <i>matName1</i> <i>matName2</i> [<i>matMatlabResult</i>]	Take the Origin matrices <i>matName1</i> and <i>matName2</i> and create a complex matrix in MATLAB that combines the two Origin matrices. The first matrix is used for the real component and second one for the imaginary component. If the name of the MATLAB matrix is not specified, <i>matName1</i> will be assigned. Existing windows of the same name are overwritten.

The Import Button

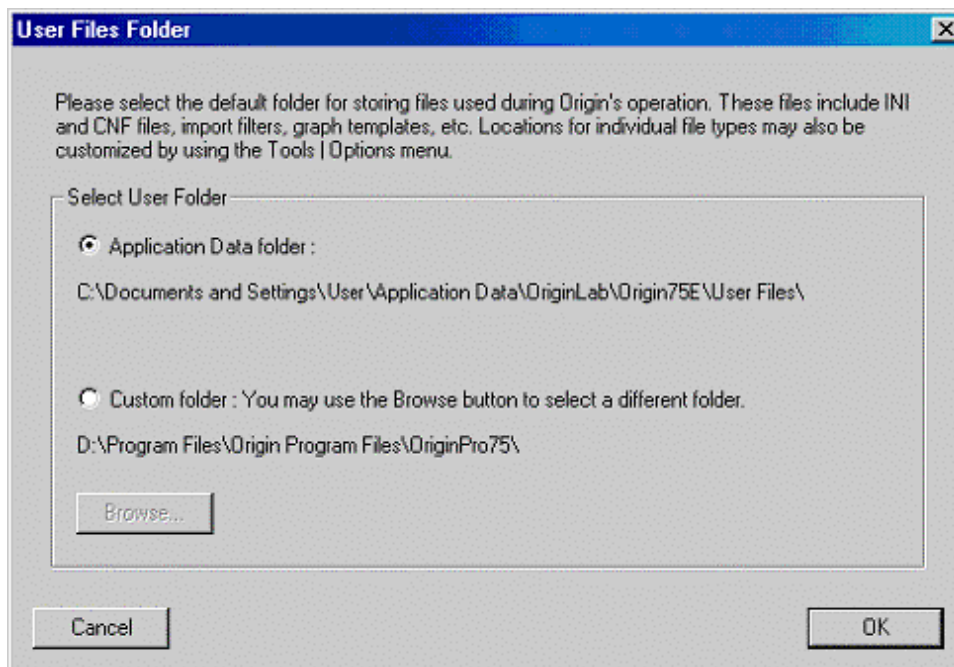
The **Import** button in the top right corner of this dialog brings up the **MATLAB Import Dialog**. This dialog lists all variables in the current MATLAB workspace. You can select a single variable, or use SHIFT + select to select multiple variables, and import them into Origin. Note that when importing, you can either bring the data into a worksheet, or into a matrix. Check box options allow you to update existing Origin matrices, and to add imported data to existing Origin worksheets.

Note: The **Tools:MATLAB Console** menu command opens a new instance of the MATLAB application. To share your MATLAB workspace with Origin, you need to (1) launch Origin first, then (2) launch MATLAB using this menu command within Origin. Once you have selected this Origin menu command and an instance of MATLAB is launched, you can go to the MATLAB application and work directly in MATLAB. The workspace can then be accessed from Origin using the **Import** button on the Origin MATLAB Console window.

Setting Your Preferences

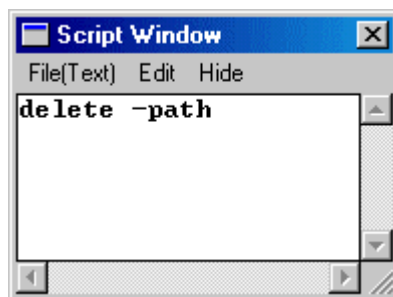
The "User Files" Folder

The first time that you run Origin, you are presented with this dialog box in which you are asked to specify a default folder for saving your customized files -- the **User Files** folder. You will always have a chance to save files to a different location, but this folder serves as a convenient place to store custom graph templates, Themes, curve fitting functions, Origin Import Filter (OIF) files, etc.



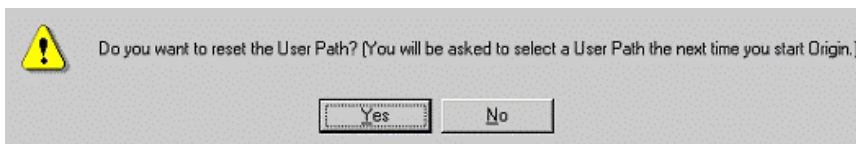
If you should decide to change the location of your User Files folder, you will need to do one of the following:

- Enter a LabTalk command in the Script Window (*recommended*).
 1. From the Origin menu, select **Window:Script Window** (or press ALT + 3).
 2. Type this line in the Script Window, just as it appears in the figure:



3. Press ENTER.

Origin responds with the following attention message:



4. Click **Yes**. The next time that you run Origin, the **User Files Folder** dialog box will open and prompt you for a **User Files** path.

- Edit the Windows Registry.

1. Run **regedit**.
2. Navigate to **HKEY_CURRENT_USER->Software->OriginLab->Origin75->English->**
3. Delete the entry named **Path**.



The next time that you run Origin, the **User Files Folder** dialog box will open and prompt you for a **User Files** path.

Starting Origin with a Specific File


To start Origin using a specific window or project file:

1. Drag a supported file type from Windows Explorer onto your Origin program icon or Origin executable file (the Origin EXE file).

Supported file types include: graph templates (*.OTP), graphs (*.OGG), worksheets (*.OGW), matrices (*.OGM), projects (*.OPJ and *.ORG) and Excel files (*.XLS).

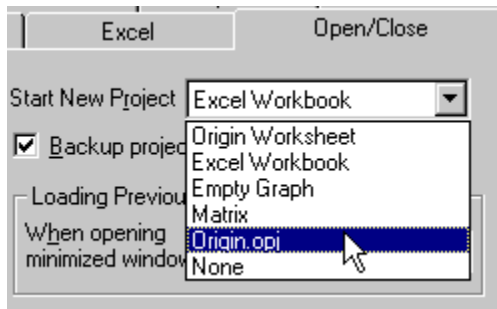
Note: You can also drag ASCII, SigmaPlot, Minitab, and Thermo Galactic SPC data files from Windows Explorer onto your Origin program icon or Origin executable file. Origin then starts with the data imported into a worksheet.

Modifying the Default Origin Project (OPJ) File

A new project is opened each time you start Origin or when you click the **New Project** button  on the Standard toolbar. In either case, the new project contains one worksheet window.

However, you can customize the contents of this newly opened project:

1. Select **Tools:Options** to open the Options dialog box.
2. Select the **Open/Close** tab and then modify the **Start New Project** setting.



Select from **Origin Worksheet**, **Excel Workbook**, **Empty Graph**, **Matrix**, **ORIGIN.OPJ**, or **None**.

The **ORIGIN.OPJ** file includes a worksheet and a graph window. The graph window is configured to display a data plot of column A (X values) and column B (Y values) automatically when data are imported or entered into the worksheet columns. You can customize the ORIGIN.OPJ project file and resave it.

Adjusting How Origin Starts by Modifying the Command Line

Using a Different Initialization File When Starting Origin

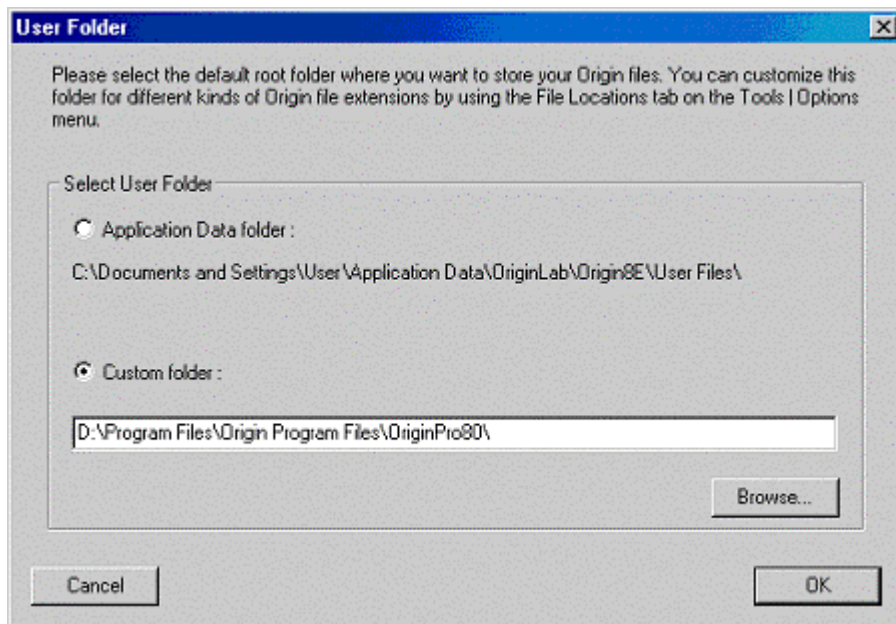
Origin's default initialization file, ORIGIN.INI, presets a number of Origin options that remain active until you close the Origin session. These options include the menu configuration and some display settings. Because Origin automatically uses ORIGIN.INI as the default initialization file, no Command Line or Target text box switch is needed to specify it.

To use an initialization file other than ORIGIN.INI, specify the replacement initialization file by using the **-i filename** switch. If ORIGIN.INI is not found and no replacement INI file is specified, default values are used for initialization.

The following command line with the **-i** switch specifies that Origin use the MYINIT.INI file to preset Origin options:

```
DriveLetter:\Origin80InstallationPath\ORIGIN80.EXE -i MYINIT
```

Note that the INI file must be in Origin program folder or the **User Folder** that you specified when you first ran Origin.



The Master INI file

Your Origin installation contains a number of INI files that control the configuration of some Origin feature, on startup. For instance, the Origin default initialization file, ORIGIN.INI, presets a number of Origin options that remain active until you close the Origin session. These options include the menu configuration and some display settings. In a typical server + client installation or on a standalone installation of Origin with multiple users, each client/user will maintain a separate version of the INI file in the **User Files** folder. This allows each client/user to customize Origin settings without overwriting the settings of other clients/users.

The Master INI file feature is designed to help alleviate some of the problems of maintaining multiple copies of system files for server + client and multi-user workstation installations. The Master INI file works in the following way:

- The Master INI file name must begin with an "M" (e.g. ORIGIN.INI becomes MORIGIN.INI, NLSF.INI becomes MNLSF.INI, etc.).
- The Master INI file must be in the Origin root folder (in the folder with the Origin EXE).

Should Origin detect the presence of a Master INI, on startup, it merges the Master INI file with the local INI file. If there is a key in Master INI file and no such key in local INI file, the key is created. If there is key in Master that exists in local, the key in the local is overwritten.

When merging of files is complete, a time stamp with the Master INI's modification time is written to the local INI file. The next time that a client/user is launched, Origin compares the Master modification time with the time stamp written to the local INI file. If the two are equal, no merging of INI files is done. It is, therefore, possible to modify the local INI file to override Master INI settings. If the Master INI is later modified, it is then merged with the local copy on client startup.

Notes on Installing and Making OPK Tools Available to Clients/Users

The systems administrator should run Origin with the Origin root folder named as the **User Files** folder. When the admin then installs the OPK file, the contents are unpacked beneath the Origin root folder.

When a new toolbar is added by installing an OPK file, an entry is written to the ORIGIN.INI file in the root folder (same as User Files folder, in this case).

For example:

```
[UserDefinedButtons]
User Defined=Oubtn.ini
Script Toolbar=OSCRIPTTOOLBAR.INI
```

This admin should add this to entry to MORIGIN.INI, to ensure toolbar access to all clients/users.

Specifying a Menu Level When Starting Origin

The menu level determines which menus are available when Origin is open. To specify the menu level at which Origin starts, use the **-l *number*** switch. The number must be valid for the lists of menus contained in the ORIGIN.INI file. If a **-l** switch is not included in the Command Line or Target text box, then a default menu level of 1 is used unless overridden by assignment within the INI file.

The following command line with the **-l** switch specifies that Origin use menu level 2 when starting Origin:

```
DriveLetter: \Origin80InstallationPath\ORIGIN80.EXE -l 2
```

Adding a New or Additional Configuration File

Configuration files are text files that contain LabTalk script commands. The configuration files define variables, menus, macros, and functions that remain active until you close the Origin session.

Configuration files execute when Origin starts as specified by the menu level in the ORIGIN.INI file.

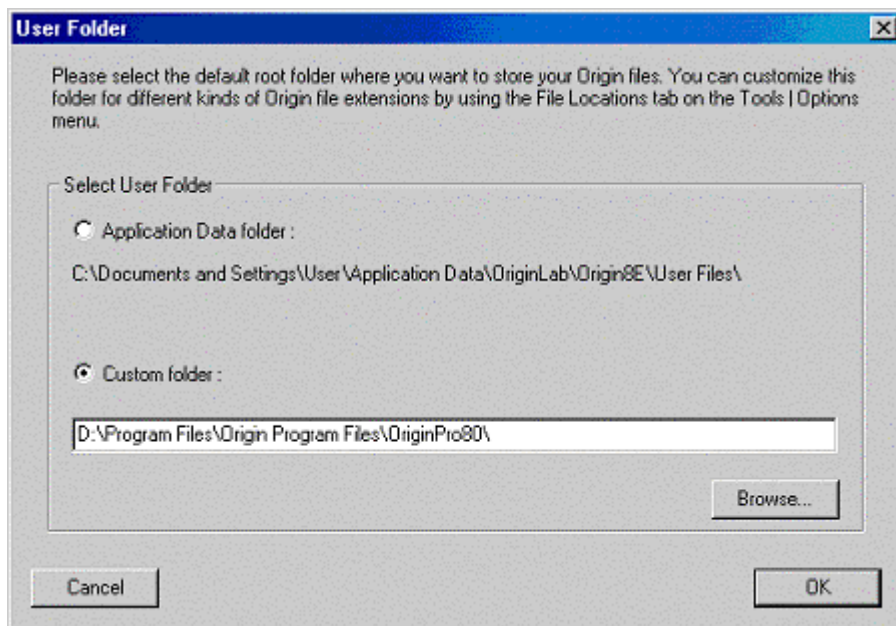
Use the **-c *filename*** switch to specify a new configuration file to override the configuration files that are specified by the menu level in the INI file.

Use the **-a *filename*** switch to specify a configuration file to add to the list of configuration files that are specified by the menu level in the INI file.

The following command line with the **-c** switch specifies that Origin use a new configuration file, MYCONFIG.CNF, to override the current configuration files specified in the ORIGIN.INI file:

```
DriveLetter: \Origin80InstallationPath\ORIGIN80.EXE -c MYCONFIG
```

Note that the configuration file must be in the Origin program folder or the User Folder that you specified when you first ran Origin.



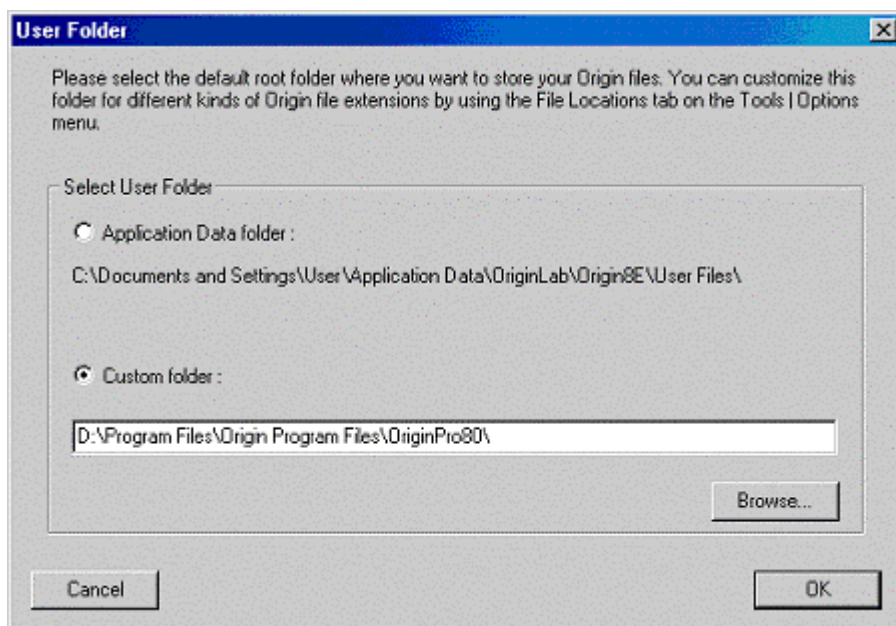
Directing Origin to Start by Opening a Worksheet Based on a Specific Template

By default, when Origin starts it opens a new project displaying a single worksheet created from the ORIGIN.OTW worksheet template. To start Origin displaying a worksheet created from a different template, use the **-tw *templateName*** switch. In addition, *templateName* will become the default worksheet template used by the New Worksheet button on the Origin Standard toolbar.

For example, to start Origin and create a worksheet based on the CONVANALYSIS.OTW worksheet template, type the following in the Command Line or Target text box:

DriveLetter:\Origin80InstallationPath\ORIGIN80.EXE -tw CONVANALYSIS.OTW

Note that the specified template must be in the Origin program folder or the User Folder that you specified when you first ran Origin.



Network Switches

The **-p** and **-w** command line switches tell a client installation of the network version of Origin where to look for client-specific files. These switches are not needed and do not work with non-network versions of Origin. Client-specific files are files that are modified by a particular client for customization purposes. These files contain such things as user preferences, settings, options, and templates. Configuration files (*.CNF), initialization files (*.INI), and template files (*.OTP, *.OTW and *.OTM) are commonly modified by individual users and need to be saved separately from the Origin server and other clients.

Use the **-p full path** switch to direct a client installation of Origin to look for client-specific files in the folder specified by *full path*.

Use the **-w** switch (with no argument) to direct a client installation of Origin to look for client-specific files in the folder specified in the Start In text box of the Origin program icon's Properties dialog box.

Note that the folder specified by *full path* and the Start In folder are normally the folder in which the client is installed.

The following command line with the **-p** switch directs Origin to look for client-specific files in the folder C:\ORIGIN70CLIENT\.

```
\\SERVER\ORIGIN\ORIGIN70.EXE -p C:\ORIGIN70CLIENT\
```

Directing Origin to Start by Opening a Specific File

To open a graph window template, an Origin window, or a project when starting Origin, you can specify the path and file name of any supported file type in the Command Line or Target text box of the Origin program icon's Properties dialog box. The supported file types include: graph templates (*.OTP), graphs (*.OGG), worksheets (*.OGW), matrices (*.OGM), projects (*.OPJ and *.ORG) and Excel files (*.XLS). No extension to the file name is required if it is a *.OPJ file.

For example, to open a project named MYPROJECTFILE.OPJ that is located in the Origin software folder, type the following in the Command Line or Target text box:

```
DriveLetter:\Origin80InstallationPath\ORIGIN80.EXE MYPROJECTFILE
```

To open a graph window named MY GRAPH.OGG that is located in the folder D:\MY OGGs, type the following in the Command Line or Target text box:

DriveLetter:\Origin80InstallationPath\ORIGIN80.EXE "D:\MY OGGs\MY GRAPH.OGG"

Note that, unlike files specified with the command line switches, you can specify files *not* located in the same directory as the Origin executable file. However, if the specified file is not in the Origin software folder, you must specify the complete path and file name. Long path and file names with spaces must be enclosed in double quotation marks. In general, the file name should be the last command line option listed when using more than one switch.

The Origin Start Up Sequence

When Origin is started by executing text contained in the Command Line text box or the Target text box of the Origin program icon's Properties dialog box, a predictable and orderly sequence of start up events takes place. Changing this sequence by the use of command line switches or by altering the contents of the ORIGIN.INI file can have complex interactions with Origin and is intended for advanced users. This section outlines the default start up sequence followed by Origin.

1. The command line is read.
2. The ORIGIN.INI (or replacement INI file) and ORIGIN80.INI files are read. The ORIGIN.INI and ORIGIN80.INI files are self-documented text files that can be opened using any text editor such as NotePad.
3. If specified, the SYSVAR file is loaded. The SYSVAR file name is specified in the ORIGIN.INI file (or in a replacement INI file) by the line:

SYSVAR = filename

where *filename* is the name of a text file located in the Origin software folder. The SYSVAR file is a mechanism for providing permanent storage of LabTalk variables whose current values are saved at the close of each project (when selecting **File:New:Project**, **File:Open**, or **File:Exit**). The SYSVAR file is a text file that can be created or opened with any text editor and should consist of lines of the form *variable = value*.

4. The files SYSTEM.CNF, OPTION.CNF, and ORGSYS.CNF are executed. Configuration files are text files that contain LabTalk script commands. The files SYSTEM.CNF and OPTION.CNF contain settings for many LabTalk **system** object properties. The file ORGSYS.CNF contains settings for several object properties and system variables as well as a number of macro definitions.
5. The file MACROS.CNF and the menu level CNF files (or an overriding CNF file) are executed. The file MACROS.CNF contains definitions for several system macros and should normally be included along with the menu level CNF files. Caution is advised if not including this file.

The menu level can be specified by the **-l number** command line switch or by the **LEVEL = number** line in the ORIGIN.INI file (if not specified, it defaults to 1). The menu level CNF files are specified by the line:

File#=Macros filename1 filename2 filename3 etc...

in the ORIGIN.INI file where File is literal, # equals *number* (the menu level), Macros is literal, and *filename1, filename2, filename3, etc...* are the menu level CNF files located in the Origin software folder. Menu level CNF files create different Origin menu arrangements depending on the value of the menu level setting. An example taken from the ORIGIN.INI file is:

File1=Macros FullMenu

6. The additional CNF file is executed. If specified (with the **-a** command line switch), the additional CNF file is executed.
7. If a file to be opened is not specified at the end of the command line and the AutoExec macro is defined, then the AutoExec macro is executed. If both conditions are met then Origin is opened with an empty workspace and the AutoExec macro is executed. The AutoExec macro is generally used to override internal default settings. A minimal and commented out definition of the AutoExec macro

can be found in the MACROS.CNF file. Not defining this macro is the normal and recommended start up sequence. If the AutoExec macro is not executed then internal defaults are set and the default worksheet template is opened by Origin.

8. If a graph template (*.OTP), a window (*.OGG, *.OGW, *.OGM), or an Excel file (*.XLS) is specified at the end of the command line, then the template, window, or workbook is opened by Origin. If defined, the macro DocEnd is executed when the newly created project file is closed. Origin creates a new project and opens the specified template, window, or workbook. If defined, Origin executes the DocEnd macro when the new project is closed. A definition statement for the DocEnd macro can be found in the MACROS.CNF file.
9. If a project file (*.OPJ or *.ORG) is specified at the end of the command line, the file ORGSYS.CNF is executed again and Origin opens the specified project file. If defined, the macros DocBegin, EndOpen, and DocEnd are executed. Origin executes the file ORGSYS.CNF a second time and then opens the specified project file. The DocBegin macro is executed just prior to the project file being opened, the EndOpen macro is executed immediately after the project file is opened, and the DocEnd macro is executed when the project file is closed. A definition statement for the DocBegin macro can be found in the ORGSYS.CNF file. Definition statements for the EndOpen and DocEnd macros can be found in the MACROS.CNF file.

See "Macro Reference" in the LabTalk Language Reference section of the Programming Help file (**Help:Programming**) for a more complete description of the **AutoExec**, **DocBegin**, **EndOpen**, and **DocEnd** macros.

Setting Your Preferences with the Options Dialog Box

Opening the Options Dialog Box

To open the *Options* dialog box:

1. From the menu, select **Tools:Options** (any Origin window active).
- or
1. From the menu, select **Window:Origin Options** (Excel workbook window active).

Saving the Settings in the Options Dialog Box for Future Origin Sessions

To control the way that Origin behaves when you make changes to the **Options** dialog box,

1. Open the Options dialog box and select the **Open/Close** tab.
 - To prompt to save Options settings

Select the **Prompt for Save on Options Dialog Close** check box (default).

To save the settings for future Origin sessions (after customizing the settings in the **Options** dialog box):

1. Click **OK** to exit the Options dialog box.
2. Click **Yes** at the "Save as Origin's startup options?" prompt.

- To save Options settings without prompting

Select the **Save Settings on Close** check box (the **Prompt for Save on Options Dialog Close** check box must be cleared).

To save the settings for future Origin sessions (after customizing the settings in the **Options** dialog box):

1. Click **OK**. Settings are automatically saved for future Origin sessions when you exit Origin.

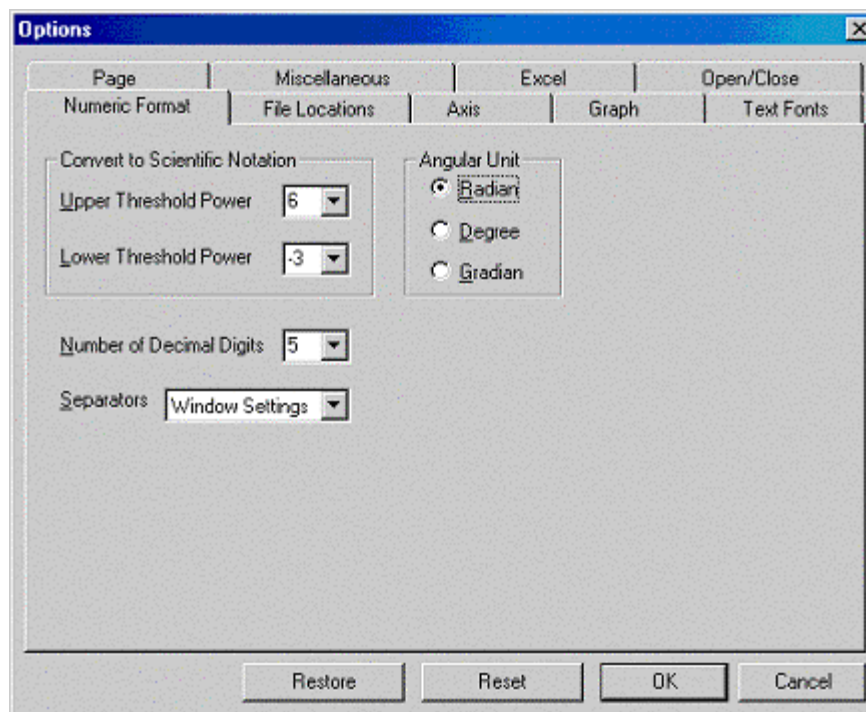
Origin saves the Options dialog box settings by updating the associated parameters in the OPTION.CNF file. This file is read automatically when Origin starts.

Reference Section: The Options Dialog Box

The Numeric Format Tab

These settings control how Origin displays and interprets worksheet data.

The (Options) Numeric Format Tab Controls



- The **Convert to Scientific Notation** Group

- ⇒ **Upper Threshold Power.** Type or select the upper threshold for conversion from decimal to scientific notation from the **Upper Threshold Power** combination box.
- ⇒ **Lower Threshold Power.** Type or select the lower threshold for conversion from decimal to scientific notation from the **Lower Threshold Power** combination box.

- The **Number of Decimal Digits** Combination Box

This combination box value controls the number of decimal digits displayed in the cell when **Default Decimal Digits** is selected from the **Numeric Display** drop-down list in the **Worksheet Column Format** dialog box.

However, when **Default Decimal Digits** is selected and the worksheet cell value *exceeds* the **Upper Threshold Power** combination box value (see above), then Origin displays five digits after the decimal place.

- The **Separators** Drop-down List

Type or select the desired numeric value separator from this drop-down list. Select **Windows Settings** to use the separator specified in the system's **Regional Settings Properties** dialog box (**Regional Settings** in the Windows **Control Panel**).

- The **Angular Unit** Group

Specify:

⇒ **Radian** (default)

⇒ **Degree**

⇒ **Gradian**

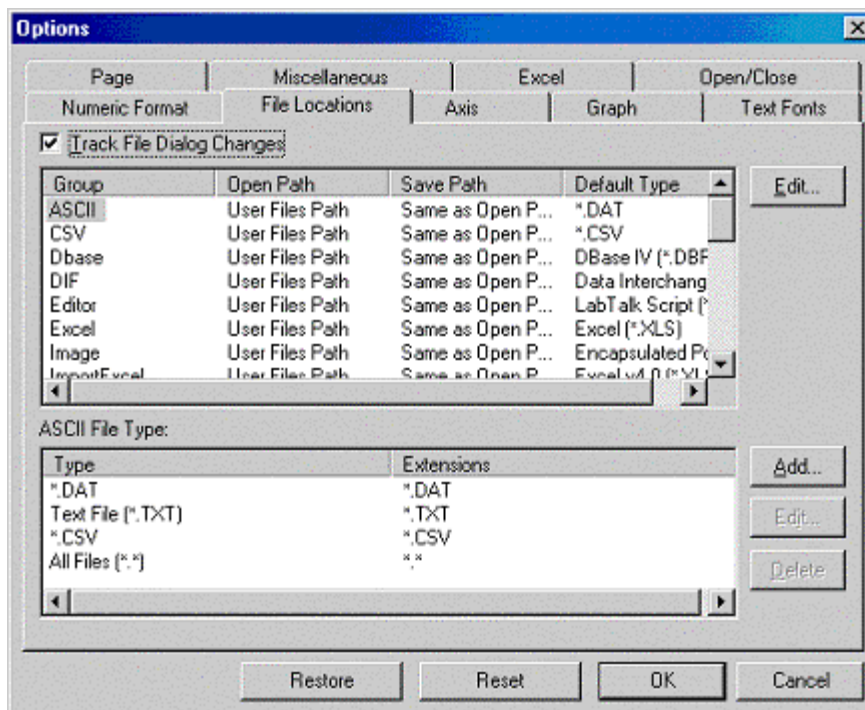
Note 1: The angular unit setting affects all trigonometric functions computed using LabTalk. For example, if **Angular Unit** is set to **Degree**, before computing a function such as $\sin(x)$, Origin converts x values to radians. This affects calculations performed in **OGS** files, the **Script Window**, **Worksheet Scripts**, **Set Column Values** and the **Label Control** dialog box.

Note 2: This setting *does not* affect computations in Origin C; Origin C always uses radians.

The File Locations Tab

Use these controls to specify file extension and "save" and "open" path information.

The (Options) File Locations Tab Controls.



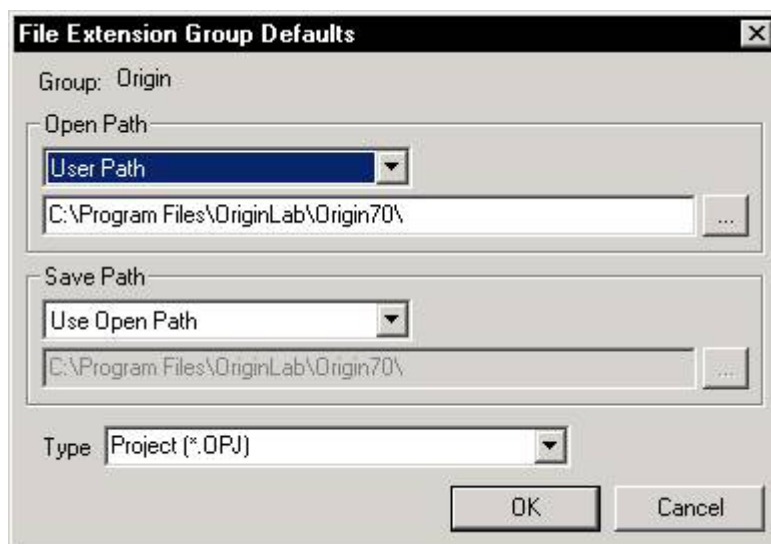
- File Tracking

By default, Origin will keep track of the file path for Origin projects, data import files, graphic export files, and other supported file types. Thus, each time you open a new project (or export a graph to a file), the path to the last opened project file (or the path to the last graphic export file) will be selected by default in the **Open** (or **Save As**) dialog box.

⇒ To turn off file tracking for all file types, select the file group from the top list box and then clear the **Track File Dialog Changes** check box.

⇒ To alter the path tracking behavior for a particular file type:

1. Leave the **Track File Dialog Changes** check box selected.
2. Select the file group from the top list box.
3. Click the **Edit** button (top right corner). This opens the **File Extension Group Defaults** dialog box for the specific group.



The **Open Path** controls tracking when opening or importing the particular file group.

User Path: Select this option to go to the same path that you last used to open a file of this group. (Note that User Path is the default setting. Thus, if you have already opened a file of this group, the path will display in the associated text box.) If you want to specify a custom path and retain it each time you open a file of this group, then click the ... button and browse to the desired path. Click OK to close this dialog box. On the File Locations tab, clear the Track File Dialog Changes check box.

Project Path: Select this option to set the default path in the Open dialog box for this file group to the path of the currently open project.

Origin Path: Select this option to set the default path in the Open dialog box for this file group to the Origin installation folder.

The **Save Path** controls tracking during saving or exporting.

Use Open Path: Select this option to set the default path in the Save As dialog box for this file group to the path that is currently set from the Open Path. Thus, if you usually want to save a project to the same location where you last opened a project, select this option.

User Path: Select this option to go to the same path that you last used to save a file of this group. (Note that User Path is the default setting. Thus, if you have already saved a file of this group, the path will display in the associated text box.) If you want to specify a custom path and retain it each time you save a file of this group, then click the ... button and browse to the desired path. Click OK to close this dialog box. On the File Locations tab, clear the Track File Dialog Changes check box.

Project Path: Select this option to set the default path in the Save As dialog box for this file group to the path of the currently open project.

Origin Path: Select this option to set the default path in the Save As dialog box for this file group to the Origin installation folder.

*Specifying the Default Type For the Open and Save As
Dialog Boxes*

The **File Extension Group Defaults** dialog box also provides a **Type** drop-down list that lists all the file types in the current group. The selection from this drop-down list determines the default type that is listed in the **Open** and **Save As** dialog boxes for the particular group. Thus, if the current group is Image and you select Joint Photographic Experts Group (*.JPG) from the Type drop-down list, then when you export a graph by selecting **File:Export Page**, Joint Photographic Experts Group (*.JPG) will display by default in the **Save as Type** drop-down list.

- The ASCII File Type List Box

This list box displays the ASCII file descriptions that display in the **Files of Type** drop-down lists when importing and exporting ASCII files, as well as the file extensions that will display in the associated **Look In** view box.

To add a file type, press **Add**. This action opens the **File Extension Type** dialog box. Type a string in the **Description** text box that will display in the **Files of Type** drop-down list when importing and exporting ASCII files. In the **Specification(s)** text box, type the file specifications for the files that will display in the **Look In** view box when importing and exporting files.

Example:

Suppose you have a third party program that outputs data to an ASCII formatted file. This formatted file is given a name with an extension .XYZ. You can have Origin display only these XYZ files in the import and export ASCII file dialog boxes by adding an ASCII File Type.

In the Description text box, you might type the name of the third party program. You might also type (*.XYZ) after the name to show what file types are associated with this third party program.

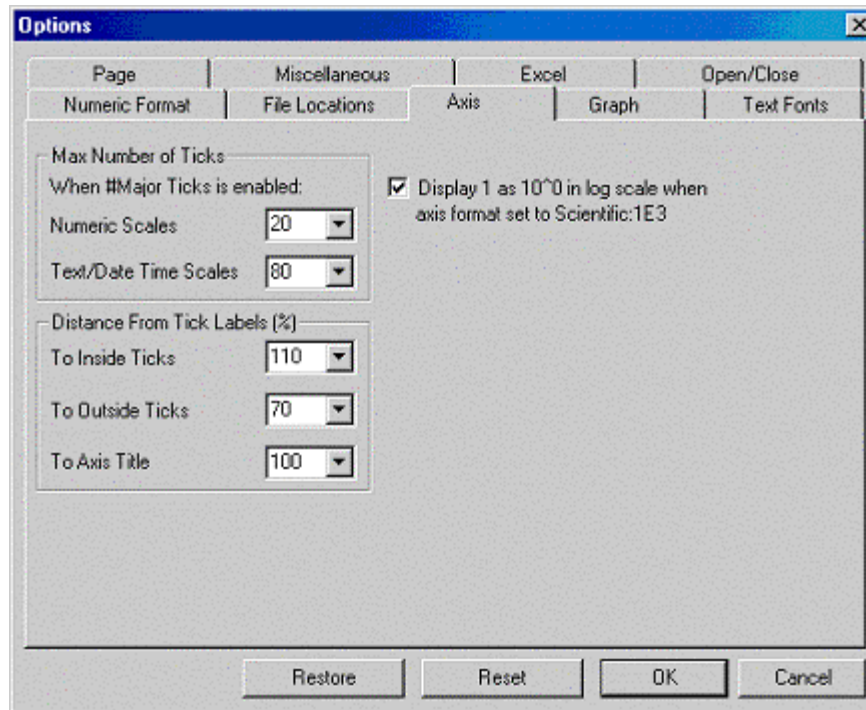
In the Specification(s) text box, you would type *.XYZ. Multiple specifications can be specified by separating them with a semicolon. Example: *.XYZ;*.XY;*.ZZ. Also, both wild cards "*" and "?" can be used.

Now when importing or exporting ASCII files, you can select your new file type from the Files of Type drop-down list and see only the files associated with this program in the Look In view box.

The Axis Tab

Settings on this tab control various graph axis format options.

The (Options) Axis Tab Controls



- The **Max. Number of Ticks** Group

- ⇒ The **Numeric Scales** Combination Box

The Numeric Scales combination box value determines the maximum number of major ticks that can be displayed in a graph window when **Numeric** is selected from the **Type** drop-down list on the **Tick Labels** tab of the **Axis** dialog box.

If the **# Major Ticks** radio button is selected on the **Scale** tab of the **Axis** dialog box and the value in the associated text box exceeds the **Numeric Scales** combination box value, then Origin displays a maximum of six major ticks in the graph window.

- ⇒ The **Text/Date Time Scales** Combination Box

The Text/Date Time Scales value determines the maximum number of major ticks that can be displayed in a graph window when **Text from Dataset**, **Time**, **Date**, **Month**, or **Day of Week** is selected from the **Type** drop-down list on the **Tick Labels** tab of the **Axis** dialog box.

If the **# Major Ticks** radio button is selected on the **Scale** tab of the **Axis** dialog box and the value in the associated text box exceeds the **Text/Date Time Scales** combination box value, then Origin displays a maximum of six major ticks in the graph window.

- The Distance from Tick Labels (%) Group

- ⇒ The To Inside Ticks Combination Box

Type or select the default distance of an “inside tick” from the tick label, in a percentage of the tick length.

- ⇒ The To Outside Ticks Combination Box

Type or select the default distance of an “outside tick” from the tick label, in a percentage of the tick length.

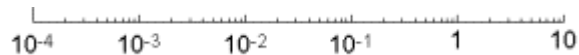
- ⇒ The To Axis Title Combination Box

Type or select the default distance of the axis title from the tick label, in a percentage of the tick length.

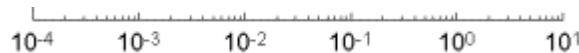
- The Display 1 as 10⁰ in Log Scale Check Box

This check box controls the format of tick labels that use Scientific notation on a logarithmic axis scale.

Clear this check box to display a logarithmic axis scale using Scientific (1E3) format as follows.



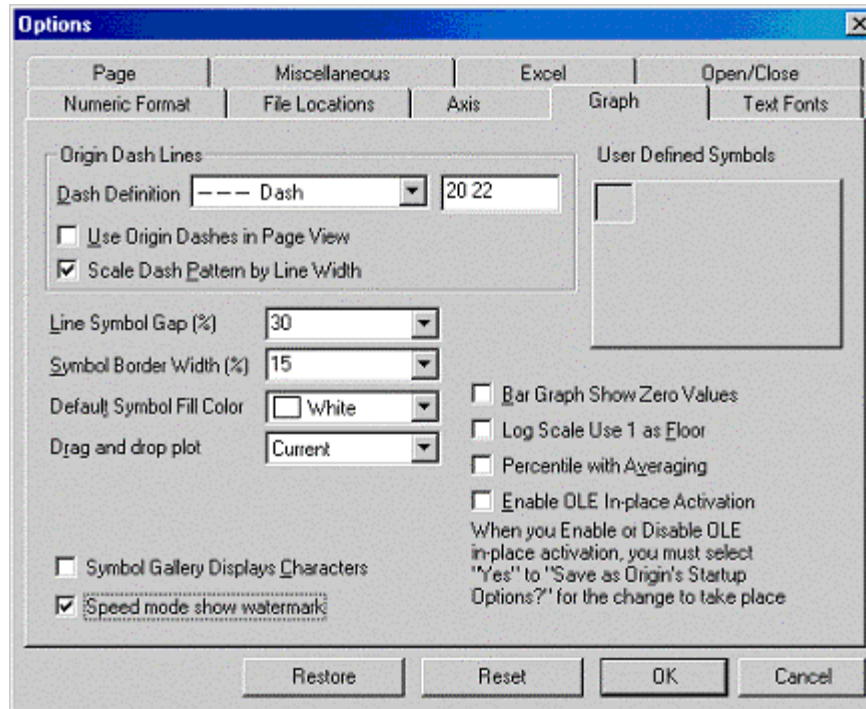
Select this check box to display a logarithmic axis scale using Scientific (1E3) format as follows.



The Graph Tab

Settings on this tab control various graph format options.

The (Options) Graph Tab Controls



- The Origin Dash Lines Group

- ⇒ The Dash Definition Drop-Down List

The Dash Definition drop-down list and its associated text box are used to customize the appearance of the line type specified in the **Plot Details** dialog box for Line, Line + Symbol and Scatter graphs. Configure the default length of the line and the space, and the size of the period, in the associated text box. For example, select Dash Dot Dot from the Dash Definition drop-down list. The default values of **18 12 5 12 5 12** display in the associated text box. These values specify that the dash is 18 units in length, the following space is 12 units in length, the following dot is 5 units in length, the following space is 12 units in length, etc. (modify these values as needed).

- ⇒ The Use Origin Dashes in Page View Check Box

Select **Use Origin Dashes in Page View** to see the settings in the **Dash Definition** drop-down list and associated text box for graph windows in **Page View** mode. If this check box is cleared, Origin uses settings as determined by the device driver (which are not adjustable).

This check box also ensures that dashes display when zooming in **Page View** mode. Origin overrides Windows' controls, enabling the pixels to redraw as dashes. This does, however, cause a slight increase in the redraw time.

⇒ The Scale Dash Pattern by Line Width Check Box

Select **Scale Dash Pattern by Line Width** to ensure that Origin scales the length and height of a dash proportionally with the space that follows it.

- The Line Symbol Gap (%) Combination Box

Type or select the desired value from this combination box to determine the gap between a symbol and line in a line+symbol data plot. Enter a value *n* to set the line and symbol gap to *n%* of the *symbol diameter*. Enter **0** to display *no gap*. The maximum allowable value is 256. (Note that the **Gap to Symbol** check box on the **Line** tab of the **Plot Details** dialog box must be selected to display a line and symbol gap.)

- The Symbol Border Width (%) Combination Box

Type or select the desired value from this combination box to determine the border width of hollow or open symbols in a scatter or line+symbol data plot. Enter *n* to specify the width of the symbol border as *n%* of the symbol's *half diameter*.

- The Default Symbol Fill Color Drop-down List

Select the fill color that displays when **Automatic** is selected from the **Fill Color** drop-down list on the **Symbol** tab of the **Plot Details** dialog box.

- The Drag and Drop Plot Drop-down List

Select the data plot type for drag and drop plotting. Select **Current** to use the current data plot style holder of the graph layer.

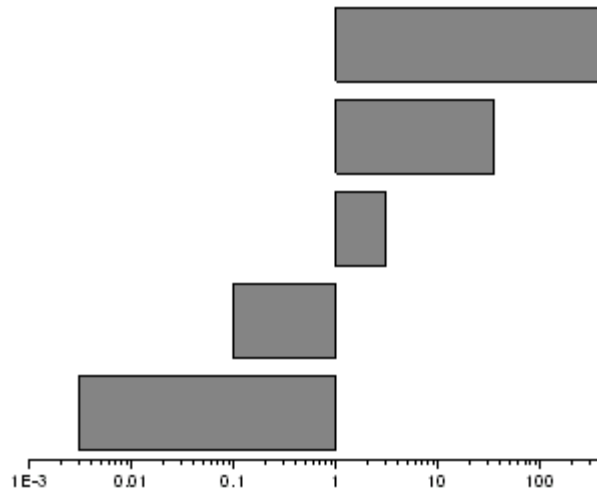
- The Bar Graph Show Zero Values Check Box

Select this check box to display a line at Y=0 for zero bar (or column) values in a bar (or column) graph.

continued...

- The **Log Scale Use 1 as Floor** Check Box

Select the **Log Scale Use 1 as Floor** check box to establish Y=1 as the "floor", or Y value which alters the direction of bar (and column) graphs displayed on a logarithmic scale. This option enhances the display of logarithmic values less than one in a bar (and column) graph.



- The **Symbol Gallery Displays Characters** Check Box

Select this check box to display alphanumeric characters in the symbol gallery on the **Symbol** tab of the **Plot Details** dialog box.

- The **Percentile with Averaging** Check Box

If this check box is *selected*, Origin will perform interpolation for determining percentile values in statistical analyses.

If this check box is *cleared*, the percentile calculations will be rounded off. The percentile value will be rounded up to the next member of the data set for calculations below the 50 percentile mark, and will be rounded down for calculations above the 50 percentile mark. The percentile value for the 50 percentile mark is rounded down.

The status of this check box will affect the percentile lines drawn on statistical graphs such as box charts, and also the percentile values reported in results of statistical analyses such as **Analysis:Statistics on Columns**.

- The **Enable OLE In-place Activation** Check Box

Select this check box to activate in-place activation. In-place activation allows you to edit an Origin object that is embedded in a destination application within the window of the destination application. Origin's tools are available within the destination window.

Note: We do not recommend in-place activation as you do not have access to the worksheets containing the data plots.

- The **User-defined Symbols** Grid

You can display bitmaps that you have created in other programs as symbols in your graph. The bitmaps must be less than or equal to 16 x 16 pixels. If a bitmap is larger than this, Origin will display only the upper-left corner of the bitmap. These bitmaps will

display in the symbol gallery on the **Symbol** tab of the **Plot Details** dialog box. They will also be available from the **Show Construction** controls on the same tab.

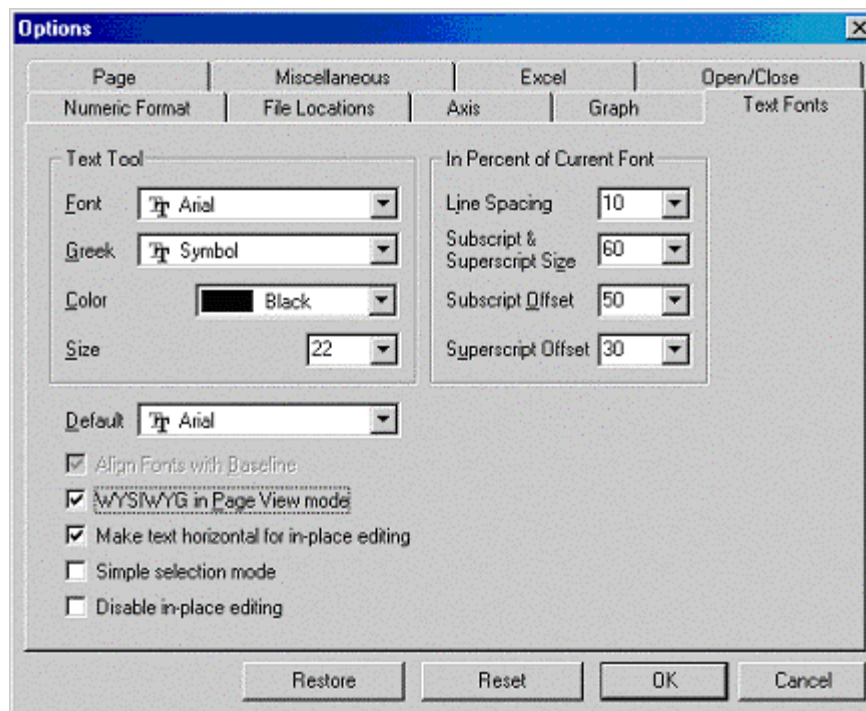
To add a bitmap to the grid:

1. Copy your bitmap to the Clipboard.
2. Click with the left mouse button to select a cell in the grid area.
3. Press CTRL+V to paste the bitmap into the cell.

The Text Fonts Tab


Use these controls to specify various text label font format options.

The (Options) Text Fonts Tab Controls




- The Text Tool Group


- ⇒ The **Font** Drop-Down List

Select the default font that displays when you create a text label with the **Text**  tool.


- ⇒ The **Greek** Drop-Down List

Select the font to be used when you click the **Greek**  button on the **Format** toolbar or in the **TextControl** dialog box.

⇒ The **Color** Drop-Down List

Select the default color that displays when you create a text label with the **Text**  tool.

⇒ The **Size** Combination Box

Select or type the default text point size used when you create a text label with the **Text**  tool.

- The **Default** Drop-down List

Select the font to be used when **Default** is selected from the font drop-down list in the **Text Control** dialog box.

Note: When you open a co-worker's project containing text labels created using the "default" font, note that you may see some differences because Origin displays these text labels using *your* default font.

- The **Align Fonts with Baseline** Check Box

This check box applies to all text labels using multiple fonts. When this check box is selected, the bottom of the letters and symbols in a line of a text label align horizontally (for most fonts). This is useful when using several different fonts in the same line of a text label, particularly when using **Greek** symbols.

- The **WYSIWYG in Page View Mode** Check Box

This check box applies only to text objects that are displayed in the graph window. If selected, Origin uses the device driver to display the text labels in the graph window when Page view is selected (**View:Page View**). The text labels will be displayed in the graph window exactly as they will appear in the printed graph. The other objects in the graph window are still displayed using the screen driver.

- The **Make Text Horizontal for In-Place Editing** Check Box

Select this check box to rotate text labels to the horizontal position during in-place editing. Original orientation is restored when text label is de-selected.

Clear the check box to maintain the text label's true orientation while editing.

- The **Simple Selection Mode**

Select this check box to disable mouse-click access to the rotation and skewing handles of a label.

- The **Disable In-place Editing Mode**

Select this check box to disable the in-place editing mode. When the in-place editing mode is disabled, double-clicking the label opens the **Text Control** dialog box.

- The **In Percent of Current Font Group**

⇒ The **Line Spacing** Combination Box

This combination box value controls the space between lines in a text label, as (a percentage of the current font size + current font size).

For example, a 20 point font size and 10% **Line Spacing**, produces a 22 point space between lines of text within a single label.

⇒ The Subscript and Superscript Size Combination Box

This combination box value controls the size of a subscript and superscript in a text label, as a percentage of the current font size.

⇒ The Subscript Offset Combination Box

This combination box value controls the offset of a subscript from the baseline of a text label, as a percentage of the current font size. The subscript displays the specified percent below the baseline.

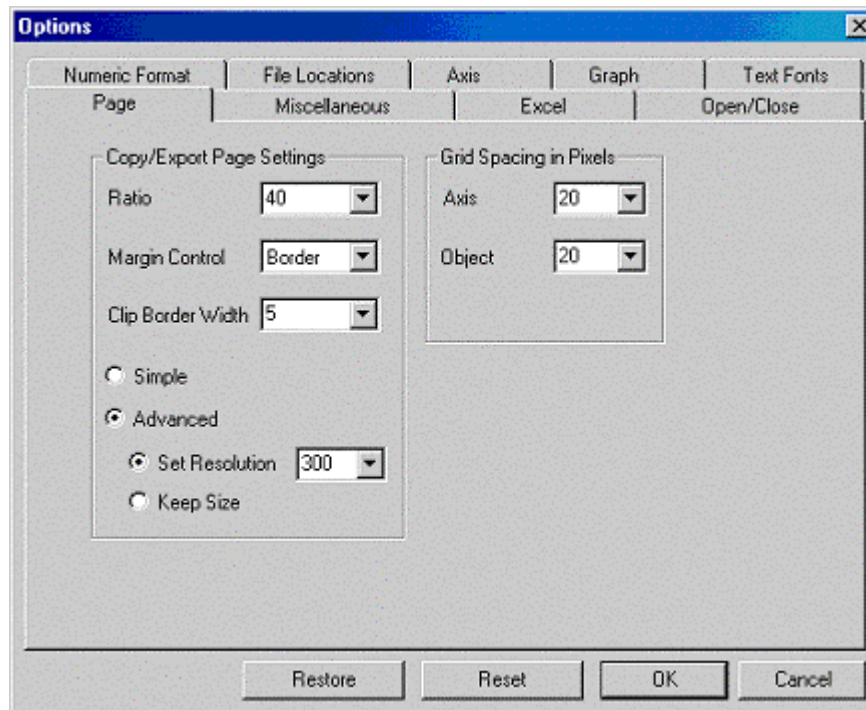
⇒ The Superscript Offset Combination Box

This combination box value controls the offset of a superscript from the top of a text label, as a percentage of the current font size. The superscript displays the specified percent above the top.

The Page Tab

These settings control the page size of exported graphs and axis and object grid spacing.

The (Options) Page Tab Controls



- The Copy/Export Page Settings Group

This group provides controls for copying a graph to the Clipboard and for exporting a graph to a **vector** image file. Vector image files include: Adobe Illustrator (*.AI), Computer Graphics Metafile (*.CGM), AutoCAD Drawing Interchange (*.DXF),

Encapsulated PostScript (*.EPS), Enhanced Metafile (*.EMF), Portable Document Format (*.PDF), and Metafile (*.WMF).

Note: Starting with Origin 7.5, the **Margin Control** and the **Clip Border Width** combo box settings *do* apply to *raster* images as well as vector and Clipboard images. The **Ratio** and **Simple/Advanced** controls *do not* apply to raster images.

⇒ The **Ratio** Combination Box

Controls the size of the page when pasted into another application, or when exported to a *vector* graphic file. The units are as a percent of the Origin page size (set to 100 for 100%, etc.)

⇒ The **Margin Control** Drop-down List

This drop-down list value controls the amount of the page in the graph window that is copied when selecting **Edit:Copy Page**, as well as when exporting to a vector graphic file. The “bounding box” used in the **Border** and **Tight** modes is page specific. The bounding box is determined by the smallest rectangular box required to completely encompass all objects on the graph page.

Select **Border** to copy the page (or export the graph) within the bounding box *plus* add the border that is specified in the Clip Border Width combination box.

Select **Tight** to copy the page (or export the graph) within the bounding box.

Select **Page** to copy the entire page (or export the graph) in the graph window.

Note 1: “Page” is defined as the area within the white (default) background behind your Origin graph(s). The dimensions of this area are defined by your printer’s “printable area.” Occasionally, upon exporting your graph (either by selecting **Edit:Copy Page**, or using one of Origin’s vector formats), you will see that your graph has unexpectedly shrunk to a fraction of its anticipated size.

Note 2: On occasion, an object exists somewhere outside the graph page (for example, a text object that has been created, dragged off the page, and forgotten). When Margin Control is set to Border or Tight, Origin draws the bounding box around all objects on the graph, including unseen objects that may be located outside the page. This has the effect of shrinking the exported graph. In such cases, set the **Margin Control** to **Page** and only objects that lie within the page – that is, within the white background behind your Origin graph – will be exported.

⇒ The **Clip Border Width** Combination Box

This combination box is only available if **Border** is selected from the **Margin Control** drop-down list. This value determines the border that is included when selecting **Edit:Copy Page**, or when exporting to a vector graphic file. The value is in percentage of the width of the bounding box.

⇒ The **Simple** and **Advanced** Controls

Graphs exported to a vector file or copied in Origin 6.0 and Origin 6.0 SR1 sometimes exhibited skewed or stretched symbols, improperly sized columns or bars, and text label spacing problems when inserted into a receiving application such as Microsoft Word. The **Simple** and **Advanced** radio buttons (and related controls) are provided to fix these problems.

Note that the default settings (**Advanced**, **Set Resolution = 300**) will correct most export and copy problems experienced in the earlier versions.

The Simple mode provides output that most resembles Origin version 5.0. However, it does NOT support the following:

- Hatching of a nonrectangular area (for example, the use of a fill pattern), as can be found in fill area, contour, and 3D XYY plots.
- Fill Area Exclusive Broken by Missing Values mode.

The Advanced mode should not have the sizing, spacing, and skewing problems described previously when working in NT 4.0 and Windows 2000. However, in Windows 98 and Windows 95, the nonrectangular hatching may still fail, although it may also depend on the container.

The best technical quality is achieved with the Set Resolution mode set *between 300 and 600 DPI*. This Set Resolution setting does not affect the physical dimensions of most vector files, EMF being the exception.

When exporting EMF files, the real size of the picture will be approximately the desired size multiplied by the ratio between this Set Resolution setting and the screen resolution (see Note). This enlarged size will not be reported by containers (receiving applications) such as Microsoft Word or CorelDraw 9 if you paste the picture, but it will be reported if the graph is exported to a file and then inserted into these applications. It turns out, though, that Microsoft Word automatically resizes the inserted picture to a reasonable size. However, CorelDraw seems to be less predictable. If necessary, manually resize the inserted picture in CorelDraw.

The Keep Size radio button in the Advanced mode provides output that most resembles Origin version 6.0 and Origin 6.0 SR1. Selecting this radio button will ensure that the size is in exact proportion to the page settings (**Format:Page**) as defined by the Copy Page Ratio combination box value on this Options dialog box tab. Unfortunately, selecting the Keep Size radio button yields the worst technical quality, particularly for small Copy Page Ratio settings.

In general, *it is best to use the Advanced mode and select a Set Resolution setting between 300 and 600 DPI*. While you can expect that higher resolutions will produce a sharper image, there is a limit beyond which there will be no noticeable effect.

If, for instance, an EMF is generated with a resolution of 900 and rendered on a printer with a dpi (resolution) of only 300, the EMF will contain more information than can be used by the printer. Even in cases where the printer does support higher resolutions (say 1200 dpi), there will be little visible improvement from 600 dpi to 1200 dpi.

If you find that some devices or containers (receiving applications) do not reproduce the graph correctly, try adjusting the Page tab settings based on the information provided here.

Note: To determine Screen Resolution, right-click on your desktop and select **Properties**. Select the Settings tab (or a similar tab) and look for the Font DPI setting.

- The **Grid Spacing in Pixels** Group

- ⇒ The **Axis** Combination Box

Type or select the desired value from this combination box to set the spacing of the axis grid lines in pixels.

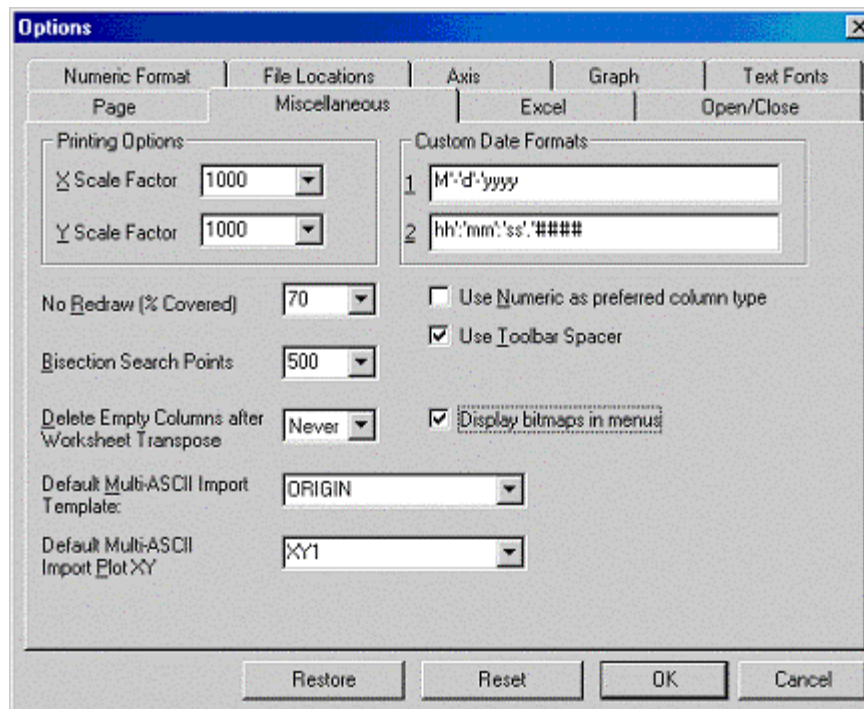
Note: To view the grid lines, select **View:Show:Grid Type**.

- ⇒ The **Object** Combination Box

Type or select the desired value from this combination box to set the spacing of the object grid lines in pixels.

The Miscellaneous Tab

The (Options) Miscellaneous Tab Controls



- The **Printing Options** Group

- ⇒ **X Scale Factor**

This combination box value determines the X scale adjustment for printing. Modify the default value if your printer does not produce a

graph with the width specified in the Width text box on the Size/Speed tab of the layer's Plot Details dialog box. For example, if you specify a width of 6 inches in the Width text box, but your graph prints 6.0625 inches wide, set the X Scale Factor combination box value to 1010, because $(6.0625 \times 1000) / 6 = 1010$.

⇒ **Y Scale Factor**

This combination box value determines the Y scale adjustment for printing. Modify the default value if your printer does not produce a graph with the height specified in the **Height** text box on the **Size/Speed** tab of the layer's **Plot Details** dialog box.

- **The Custom Date Formats Group**

This group allows you to define your own custom date formats. These custom date formats will display in the **Display** drop-down list when **Date** is selected from the **Format** drop-down list in the **Worksheet Column Format** dialog box.

When you specify a custom date format, there should be no more than 60 characters in the custom date string. "Sandwich" format strings such as TIME-DATE-TIME or DATE-TIME-DATE are not allowed.

Use the following elements to construct a custom date string:

Type this...	To signify...	What displays in Origin
M	Month	<p>M = number of month (for example, January = 1). Separators (enclosed in single quotes) must follow this element.</p> <p>MM = 2 digit number of month (for example, January = 01).</p> <p>MMM = three letter abbreviation (for example, Jan).</p> <p>MMMM = full month name (for example, January). Separators (enclosed in single quotes) must follow this element.</p>
d	Day	<p>d = day of month (for example, 1). Separators (enclosed in single quotes) must follow this element.</p> <p>dd = two digit day of the month (for example, 01).</p> <p>ddd = three letter abbreviation of day (for example, Mon).</p> <p>dddd = full day name (for example, Monday). Separators (enclosed in single quotes) must follow this element.</p>
y	Year	<p>y = last 1 or 2 digits of year (for example, 1901 = 1). Separators (enclosed in single quotes) must follow this element.</p> <p>yy = last 2 digits of year (for example, 1901 = 01).</p> <p>yyyy = full year (for example, 1901 = 1901).</p>

Type this...	To signify...	What displays in Origin
h	Hour	h = hours with no leading zero for single-digit hours; 12-hour clock. Separators (enclosed in single quotes) must follow this element. hh = hours with leading zero for single-digit hours; 12-hour clock.
H	Hour	H = hours with no leading zero for single-digit hours; 24-hour clock. Separators (enclosed in single quotes) must follow this element. HH = hours with leading zero for single-digit hours; 24-hour clock.
m	Minute	m = minutes with no leading zero for single-digit minutes. Separators (enclosed in single quotes) must follow this element. mm = minutes with leading zero for single-digit minutes.
s	Seconds	s = seconds with no leading zero for single-digit minutes. Separators (enclosed in single quotes) must follow this element. ss = seconds with leading zero for single-digit seconds.
#	Decimal after seconds	# = one digit after the decimal point for seconds. ## = two digits after the decimal point for seconds. ### = three digits after the decimal point for seconds. #### = four digits after the decimal point for seconds.
t	Time marker	t = one character time marker string, such as A or P. tt = multi-character time marker string, such as AM or PM.

Examples

To create a custom 1 date selection that displays the format:

Saturday, September 5, 1998

type:

dddd', 'MMM' 'd', 'yyyy

The elements in the custom date string must be in uppercase or lowercase (for example, "MM" not "mm" for months). Elements in the custom date string may be separated by any alphanumeric character not listed above. If an element does not clearly specify how many characters should be expected on input, it must be followed by a separator enclosed in single quotes. If the element is last in the format string, the separator does not have to be in single quotes. Separators will appear in the same location in the worksheet display.

However, the single quotes will not be displayed. You can not have two separators in single quotes adjacent to each other. For example, "ddd '|' '-MMM" is forbidden.

When a space is enclosed in single quotes, it is used as a parser. This means that the data that is put in the cell must have the same number of characters between data values as are enclosed in the single quotes. If you want to add space to data that does not already have it, use unquoted separators in the custom date string. These spaces, however, will be used only for display purposes, not for parsing an input date/time string. See the following table for examples.

Custom Date	Input	Output	Notes
MM dd	0416	04 16	The unquoted space was ignored by the parser. Therefore, the input was strictly according to the format.
MM' 'dd	02 12	02 12	The format expected just one space separator, but it is acceptable to have extra spaces in the string.
MM' 'dd	0212	-	A space separator was expected, so the parser failed.

- Additional Controls

- ⇒ The **No Redraw (% Covered)** combination box value controls the redrawing of windows. Origin will not redraw a window if that portion of the window that is covered by another window exceeds this value.
- ⇒ The **Bisection Search Points** combination box value speeds up the search process when using the Data Reader tool or when double-clicking on a data plot. When you click on a data plot using the Data Reader tool, Origin begins searching for the nearest point using a sequential or bisection search. If the number of data points is less than the bisection search value, then sequential search is used. If the number of points is greater than the bisection search value, then bisection search is used. (Note that the bisection search requires a sorted X data set.)
- ⇒ The **Delete Empty Columns After Worksheet Transpose** combination box controls whether or not Origin deletes empty columns after transposing worksheet columns and rows.
- ⇒ The **Default Multi-ASCII Import Template** drop-down list controls the default worksheet template used when importing multiple ASCII files into multiple worksheets.
- ⇒ The **Default Multi-ASCII Import Plot XY** drop-down list controls the default setting in the **Plot Designation Column** list of the **Import Multiple ASCII** dialog box.

Option	Result
XY1	Origin will import all the columns. Origin assumes the first column contains X values and all remaining columns contain Y values. In this case, the "1" indicates that the last character "Y" is repeated for all remaining columns.
DXY1	Origin will import all the columns. Origin assumes the first

	column contains values that should be disregarded. Origin assumes the second column contains X values and the remaining columns contain Y values. "1" indicates that the last character "Y" is repeated for all remaining columns.
XY	Origin will import the first and second columns as X and Y values respectively.
XY2	Origin will import all the columns. However, in this case Origin assumes the first column contains X1 values, the second column contains Y1 values, the third column contains X2 values, the fourth column contains Y2 values, and so on. In this case, the "2" indicates that the last two characters "X" and "Y" are repeated for all remaining columns.
XYE	Origin will import the first, second, and third columns as X, Y, and Y error values respectively.
XYZ	Origin will import the first, second, and third columns as X, Y, and Z values respectively.

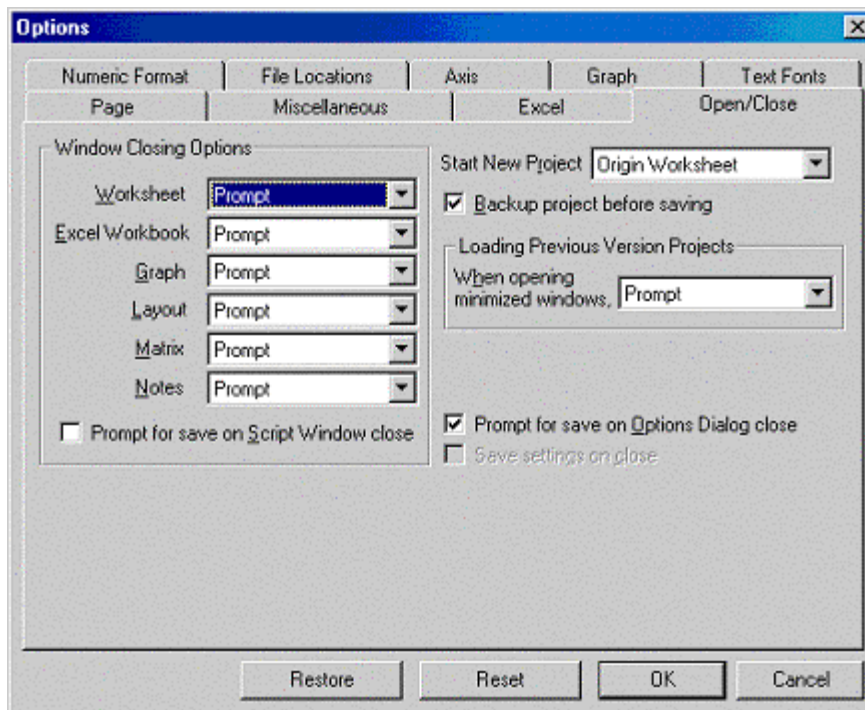
- ⇒ The **Use Numeric as Preferred Column Type** check box controls whether all columns in all new worksheets are of Numeric or of Text & Numeric type (default). If you are planning on sharing your Origin project with a colleague who has **Origin 4.1**, you should select this check box. Failing to do this could cause a loss in data when the project is opened in Origin 4.1.
- ⇒ Select the **Use Toolbar Spacer** check box to display a toolbar spacer below the menu bar. The toolbar spacer ensures that the toolbar area remains at a fixed width when changing the active window. The height of the toolbar spacer is determined by the maximum height required to display all the selected toolbars for any of the windows in the project.

(To hide the toolbar spacer, right-click in the toolbar spacer region and select **Hide Toolbar Spacer** from the shortcut menu.)
- ⇒ The **Display Bitmaps in Menus** check box controls whether or not bitmaps display next to menu commands. Menu commands that have toolbar button access have bitmaps that display to the left of the command.

The Open/Close Tab

Controls for opening and closing behaviors of Origin child windows and projects.

The (Options) Open/Close Tab Controls



- The Window Closing Options Group

- ⇒ Worksheet, Excel Workbook, Graph, Layout, Matrix, and Notes

Opt to **Hide** or **Delete** a child window without incurring an attention message confirming your action (i.e. to hide a window instead of deleting it, select Hide Only from the drop-down list). **Prompt** is the default behavior.

- ⇒ Prompt for Save on Script Window Close Check Box

Select this check box to display a prompt when closing the Script window (if the contents have been modified). This prompt also displays when exiting Origin if the Script window contents have been modified.

- Additional Controls

- ⇒ Start New Project Drop-Down List

This drop-down list allows you to select the window or project you want to have displayed when you open a new project. You can select from worksheet, Excel workbook, empty graph, matrix, ORIGIN.OPJ, or none. The ORIGIN.OPJ file includes a worksheet and a graph

window. The layer contents of the graph window is configured to display the column B data set.

⇒ **Backup Project Before Saving Check Box**

Select this check box to automatically create a backup of the currently saved file before re-saving. Origin renames the saved file BACKUP.OPJ, and then saves the altered file using the specified file name.

⇒ **When Opening Minimized Windows Drop-Down List**

This drop-down list allows you to select how windows that are saved as minimized in pre-version 6 projects open in Origin 6. Opening minimized windows as hidden windows improves the loading time of your project. Hidden windows can be accessed from the Project Explorer.

⇒ **Prompt for Save on Options Dialog Close Check Box**

Select this check box to open an attention dialog box after the Options dialog box is closed, asking if you want to save the changes as Origin's startup options.

⇒ **Save Settings on Close Check Box**

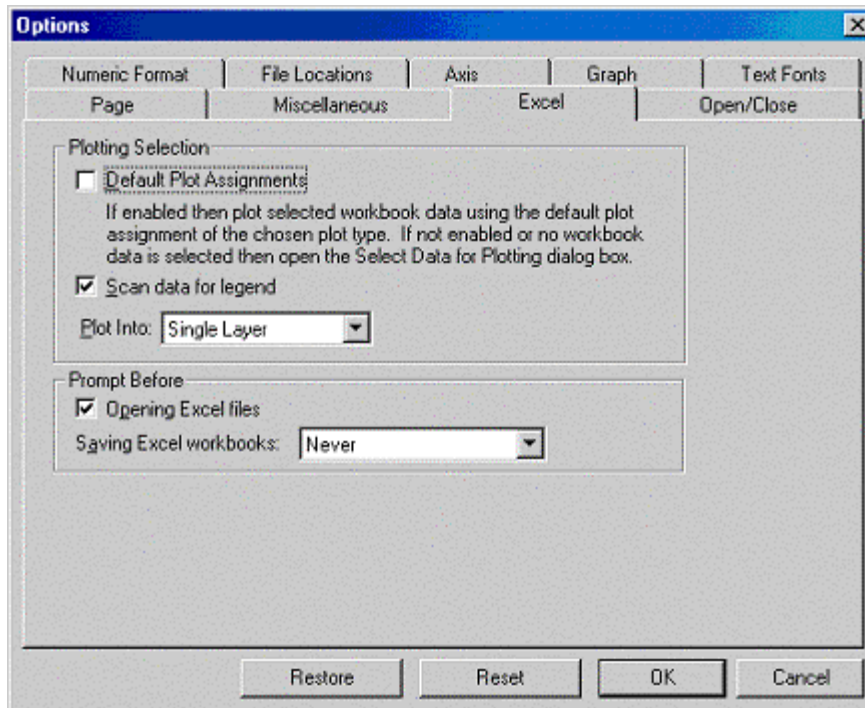
When **Prompt for Save on Options Dialog Close** is *cleared*, then the **Save Settings on Close** check box is available.

Select this check box to automatically save the changes to the Options dialog box as Origin's startup options.

Clear the check box to restore the default options when you exit Origin.

The Excel Tab

The (Options) Excel Tab Controls



- The Plotting Selection Group

- ⇒ The Default Plot Assignments Check Box

Select this check box to plot by highlighting the workbook data and assuming column designations appropriate to a selected graph type. If no workbook data is highlighted when the graph type is selected, Origin opens the **Select Data for Plotting** dialog box.

- ⇒ The Scan Data for Legend Check Box

Select this check box to create a graph legend by automatically searching the associated workbook for text. For each data plot, Origin begins searching for legend text in the cell immediately above the cell that contains the first Y data values. Origin continues to search upward in the column until it finds text values.

- ⇒ The Plot Into Drop-down List

When selecting multiple data sets for plotting, control the display of the data plots from this drop-down list.

Select **Single Layer** to plot the selected data sets into a single layer in a graph window.

Select **Multiple Layers** to plot each selected data set into its own layer. All layers display in the same graph window.

Select **Multiple Pages** to plot each selected data set into its own layer. Each layer displays in its own graph window.

- The Prompt Before Group

- ⇒ The Opening Excel Files Check Box

Select this check box to show a dialog box that allows the user to choose how Excel files are opened in Origin.

When this check box is *selected*, the Open Excel dialog box opens when you select **File:Open Excel**, or when you click the **Open Excel** button on the Standard toolbar (and select a file and click Open). The Open Excel dialog box provides the option of opening the Excel file as an Excel workbook or as an Origin worksheet(s).

When this check box is *cleared*, Origin opens the Excel file as an Excel workbook.

- ⇒ The Saving Excel Workbooks Drop-down List

This drop-down list controls the display of a dialog box that determines how internal and external Excel workbooks are saved when you save a project that contains the workbook.

Select **Never** to prevent Origin from opening the **Save Excel Workbooks** dialog box under all circumstances. By default, external Excel workbooks are automatically updated when the project that includes the workbook is saved.

Select **Before Saving** to direct Origin to open the Save Excel Workbooks dialog box whenever you select **File:Save Project** (or whenever you click the Save button on the Standard toolbar), assuming the project includes an Excel workbook. The Save Excel Workbooks dialog box allows you to determine which (external) Excel workbook files to update when the project is saved. By default, all external Excel workbooks are updated.

Select **Before Saving Project As** to direct Origin to open the Save Excel Workbooks dialog box whenever you select **File:Save Project As**, assuming the project includes an Excel workbook. (See the Before Saving option.)

Customizing Toolbars

The Customize Toolbar Dialog Box

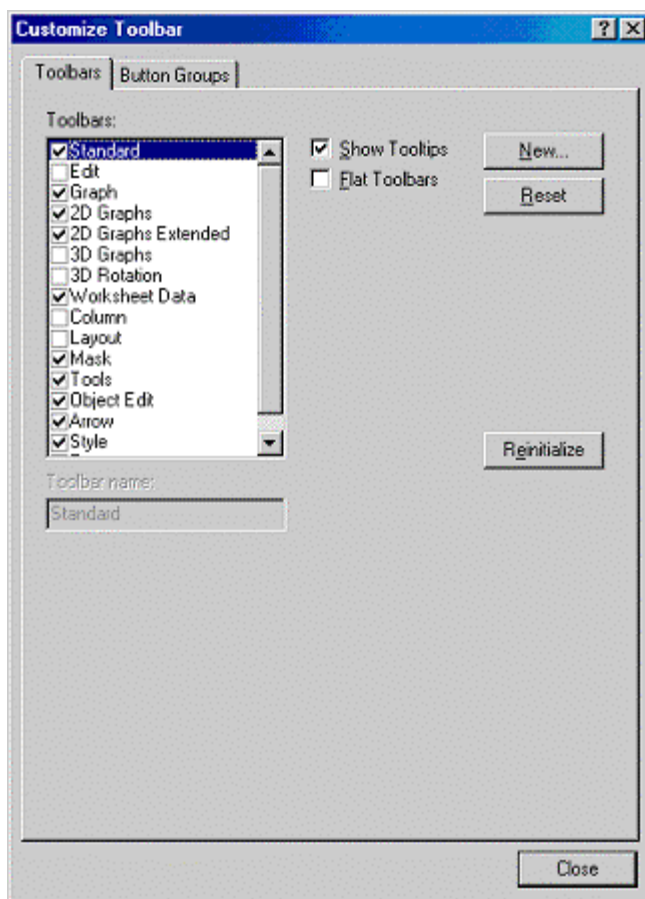
The **Customize Toolbar** dialog box provides interface control over Origin's built-in toolbars and toolbar buttons. There are two tabs in the dialog box:

The Toolbars Tab

The **Toolbars** tab includes controls to:

- Turn toolbars on and off.
- Restore built-in toolbar configurations.
- Create or delete user-defined toolbars.

Dialog Box Controls



The **Toolbars** List Box

Select or clear check boxes to turn toolbars on and off.

The **Toolbar Name** Text Box

Edit names of user-defined toolbars.

The **Show Tooltips** Check Box

Enables/disables the floating text that appears when you mouse over a toolbar button.

The **Flat Toolbars** Check Box

Toggle between flat or 3D toolbar button bitmaps.

The **New Button**

Opens the **New Toolbar** dialog box. Enter the name of your user-defined toolbar.

The **Reset/Delete** Button

Restores the default button group for a built-in toolbar.

Deletes a user-defined toolbar.

The **Reinitialize** Button

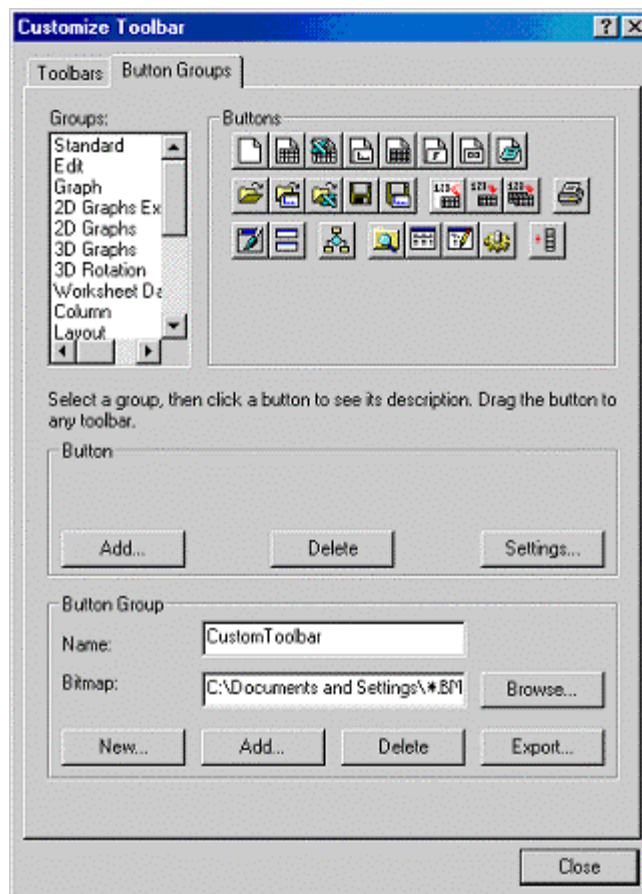
Returns all built-in toolbars to the default configuration at the time of installation. Changes take effect when Origin is restarted.

The **Button Groups** tab

The **Button Groups** tab includes controls to:

- Add (or remove) buttons to a toolbar.
- Create new button groups (new toolbars).
- Link a toolbar button with an OGS (script) file.

Dialog Box Controls



The **Groups** List Box

Lists all built-in and user-defined button groups. Select a group to see the member buttons.

The **Buttons** Group

Lists the buttons in the highlighted **Groups** button group.

Button Group: Add or Delete Buttons

Add buttons to, or delete buttons from, a user-defined Button group.

The **Settings** Button (see the topic under the next heading).


The Button Group Group

The **New** Button (see page 674)

The **Add** Button (see page 675)

The **Delete** Button (see page 676)

The **Export** Button (see page 677)

 [See your Origin software to view a multimedia demonstration on this topic \(Help:Multimedia Demonstrations\).](#)

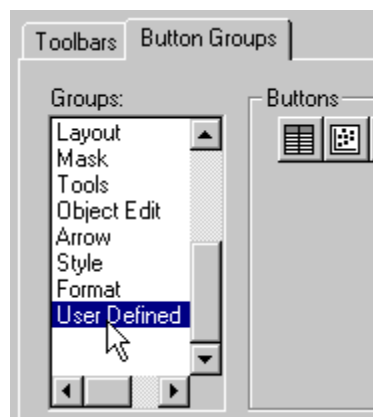
Programming a Button on the User-Defined Toolbar to Perform a Task

The **User-Defined** button group includes 10 non-preprogrammed toolbar buttons that can be associated with, and used to run, your custom tasks.



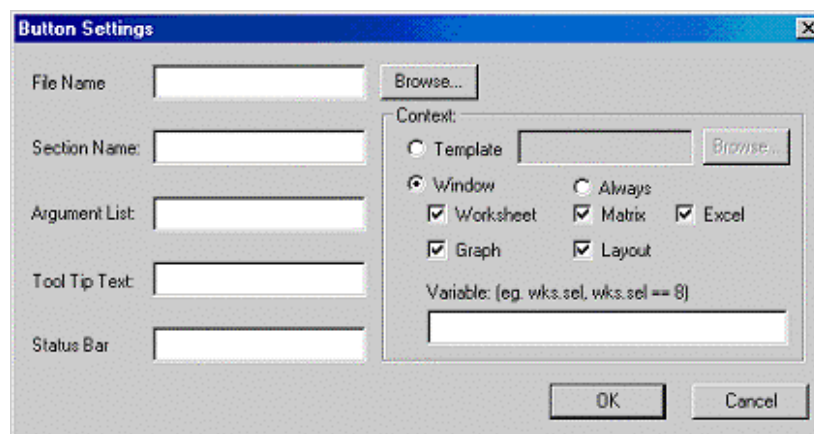
To associate a User-Defined group button with a custom task:

1. Open the **Customize Toolbar** dialog box (**View:Toolbars**) and select the **Button Groups** tab.
2. Select the **User Defined** button group from the **Groups** list.



3. Select a button in the **Buttons** group.
4. Click on the **Settings** button in the **Button** group. This opens the **Button Settings** dialog box.
5. Edit the **Button Settings** dialog box and click **OK** to complete the programming of your custom button.

The Button Settings Dialog Box



The File Name Text Box

Specify the LabTalk script file that contains the script for this button. You can specify a built-in script file or a custom script file that you or another Origin user created. Script files have the file name extension .OGS.

The script file is a text file that is organized in sections. Each of these sections is identified by the *name* of the section, surrounded by square brackets. This is a section from one of the .OGS files that is installed with your Origin software.

```
[Average1]
// yyyy format

//RKM Standard.otw now in buttons directory MOVE_STANDARD
doc -cw standard;
doc -t buttons\standard.otw;
win -r %H Standard$(count+1);
///
sum(%W, 2, $((%W, @#)));
%{H, 1}=%{W, 1};
%{H, 2}=_Mean;
%{H, 3}=_SD;
sort -c 1 3 %{H, 1};    //sort in ascending order
```

Note: To view an example LabTalk script file:

- 1) Select **File:Open**.
- 2) Select **LabTalk Script (*.OGS)** from the **Files of Type** drop-down list.
- 3) Select a script file.
- 4) Click **Open**.

For example, select ARROW.OGS. The script file opens in a LabTalk Editor window.

For more information on LabTalk, see the LabTalk Language Reference section of the Programming Help file (**Help:Programming=>LabTalk Language Reference**).

The Section Name Text Box

Specify the script file section that contains the script for this button in the **Section Name** text box.

In the script file, section names are enclosed in brackets. For example:

[SectionName]

The **ArgumentList** Text Box

To pass the script file section an argument (or arguments), type the argument(s) in the **Argument List** text box.

The **Tool Tip Text** and **Status Bar**Text Boxes

Specify the **ToolTip** and status bar messages for the button in the respective text boxes.

The **Context** Group

You can restrict the button's availability to instances when a window created from a particular template is active, or when a specific window type is active. Furthermore, you can restrict the button's availability based on the value of a specified variable. To restrict a button's availability based on a variable value, type the variable name or a test condition in the **Variable** text box (see the following example).


To determine the button's availability, Origin first checks the template and window type restrictions. If the button passes this criteria, Origin then checks to see if a variable (or object property) has been associated with the button.

If you entered a variable name in the Variable text box, Origin then checks the current numeric value of the variable. If the current variable value is zero, Origin disables the button. Otherwise, Origin enables the button. For example, if you enter **wks.sel** in the Variable text box, then whenever there is a selection in the worksheet, **wks.sel** would be non-zero, and the button would be enabled.

If you entered a test condition in the Variable text box, Origin then checks to see if the test condition is False (zero) or True (non-zero). If the test condition is False, Origin disables the button. If the test condition is True, Origin enables the button. For example, if you entered ...

wks.sel == 8

... then whenever a range of data is selected in the worksheet, this condition would be True and the button would be enabled.

 [See your Origin software to view a multimedia demonstration on this topic \(*Help:Multimedia Demonstrations*\).](#)

Creating a Group of Buttons that Perform Custom Tasks

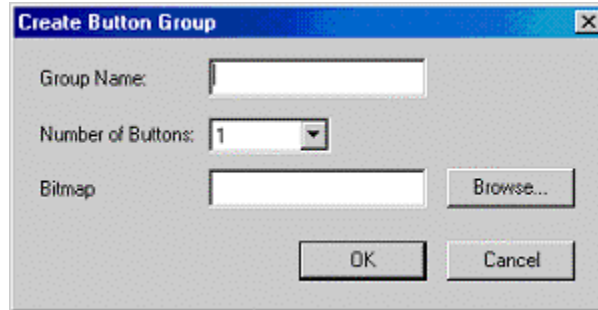
In addition to programming buttons in the **User Defined** button group, you can add new groups of custom buttons to Origin.

There are three ways that you can do this:

- Create a new button group.

To create a new custom button group:

1. Click the **New** button in the **Button Group** group. This opens the **Create Button Group** dialog box ([see figure](#)).



Specify...

- the button **Group Name**.

If you enter the name of an existing button group, Origin will prompt you to Rename, Merge, or Replace the existing button group.

⇒ **Rename** changes the new button group name.

⇒ **Merge** combines both button groups.

⇒ **Replace** deletes the existing button group and installs the new group.

- the **Number of Buttons** in the group (maximum number of buttons for a group is 50).
- the **Bitmap** file for the button(s).

The bitmap must be a 16 color bitmap. Additionally, the bitmap should consist of a 16 pixel by 16 pixel segment for each button in your custom button group. So, for instance, if you wished to create a 5 button group, your bitmap would have to measure 16 pixels by 80 pixels. Origin will parse the bitmap using the **Number of Buttons** specification.

2. Click **OK**.

If all of the information that you provided was valid, Origin opens the **Save As** dialog box. By default, the **Group Name** displays in the **File Name** text box.

3. Click **Save** to save your new group settings to the specified initialization file.

After completing these steps, your new button group displays in the **Groups** list box (on the **Button Groups** tab of the **Customize Toolbars** dialog box). You can now customize the button settings for the buttons in your group as per the procedure outlined in the topic *Programming a Button on the User-Defined Toolbar to Perform a Task* on page 672

- Copy another Origin user's custom button group to your Origin program folder.
- Install button groups that have been exported to a .OPK file.

Copying a Custom Button Group from Another Location

A custom button group (including the User Defined group) has:

- An associated initialization (.INI) file.

The initialization file is created when you click the **New** button in the **Button Group** group and then edit the **Create Button Group** and the **Save As** dialog boxes.

- A bitmap file.

The bitmap file is specified in the **Create Button Group** dialog box. This information is then added to the button group's initialization file.

- At least one LabTalk script file.

The LabTalk script files are specified for each button in the group in the respective **Button Settings** dialog box. This information is then added to the button group's initialization file.

If another Origin user (for example, a user on your network) has a custom button group that you want access to:

1. Copy the user's custom **.INI** file, **bitmap** file, and LabTalk **script** file to your Origin folder.
2. Run your copy of Origin(Pro).
3. From the menu, select **View:Toolbars** and select the **Button Groups** tab.
4. In the **Button Group** group, click **Add**. This opens the **Add Button Group** dialog box.
5. Specify the path to the **.INI** file for the button group and then click the **OK** button. The new button group now displays in the **Groups** list.

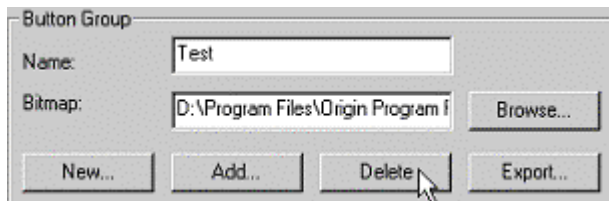
Note: The preferred way to exchange button groups is to create an **.OPK** file. For more information, see **Exporting Button Groups**.

Modifying Custom Button Groups

Deleting a Custom Button Group

To remove a custom button group:

1. Select the button group that you want to remove from the **Groups** list box.
2. Click the **Delete** button in the **Button Group** group.



An attention prompt asks for verification before removing the group.

1. If you click **Yes**, Origin removes the custom button group from the **Groups** list box. If any buttons from this (removed) group are placed on toolbars, those buttons will no longer function after you remove the group.

Note: You cannot remove built-in button groups.

Modifying the Bitmap for a Custom Button Group

Once you have added a new button group, you can modify the bitmap for the group:

1. Select the desired group from the **Groups** list box.

2. Type the new path and file name in the **Bitmap** text box, or click the **Browse** button to locate the new bitmap file.

Note: You can also modify the bitmap for the **User Defined** button group.

Removing a Button from a Custom Button Group

To remove a button from a custom button group (including the User Defined button group):

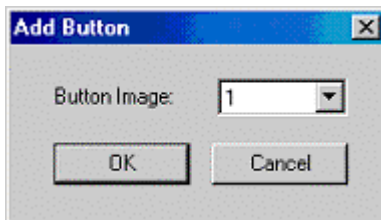
1. Select the button that you want to delete.
2. Click the **Delete** button in the **Button** group.

Adding a Button to a Custom Button Group

To add a button to a custom button group (including the User Defined button group):

1. Select the button group to which you want to add the button.
2. Click the **Add** button in the **Button** group.

The **Add Button** dialog box opens.



3. Select or enter the index number that corresponds to the button image in the bitmap file.
4. Click **OK**. The button is added to the custom button group.

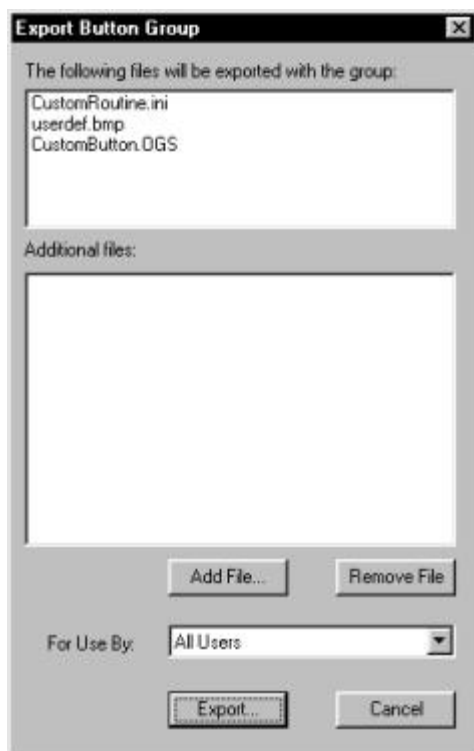
Exporting Button Groups

Creating the Export (.OPK) File

When creating a custom button group for export to a .OPK file, consider saving your button group's initialization file, bitmap file(s), script file(s), and any other support files to *a user-created subfolder* in the Origin program folder. When another Origin user installs your .OPK file, your custom subfolder will automatically be created in the user's Origin folder, and this subfolder will contain the files for the custom button group. This allows you to keep your custom files separate from the other Origin files. This is particularly helpful if your end user happens to install multiple .OPK files. **Do not** save your button group's files to a folder *outside* of the Origin program folder.

To export your custom button group (or the User Defined button group) to a .OPK file:

1. From the menu, choose **View:Toolbars** to open the **Customize Toolbar** dialog box.
2. Select the **Button Groups** tab.
3. Select your custom button group from the **Groups** list box.
4. Click the **Export** button in the **Button Group** group. This opens the **Export Button Group** dialog box.



The upper view box lists the files that will be exported to the .OPK file when you click **Export**. By default, this view box lists the initialization file and the bitmap file for the custom button group, and the LabTalk script files associated with the buttons in the group.

To add files to the list:

5. Click the **Add File** button. This opens the Open dialog box.
6. Select additional files. Additional files are displayed in the **Additional Files** view box. Note that you can *only* include files that are located in *the Origin folder or one of its subfolders*.
7. To remove an additional file, select the file you want to remove, then click the **Remove File** button.

The **For Use By** drop-down list allows you to restrict installation of your .OPK file:

- **All Users** allows anyone who receives your .OPK file to install your custom button group to their Origin folder (user must have version 6.1 or later).
- **Licensed Users** allows only users of Origin 6.1 or later to install your custom button group (excludes Evaluation software users).
- **Registered Users** allows only users who have registered and entered their Registration ID in their Origin software to install your custom button group.

To complete the creation of your .OPK file:

8. Click the **Export** button. This opens the **Save As** dialog box. By default, Origin lists the custom button group name in the **File Name** text box.
9. Edit the file name and path, as needed*.
10. Click **Save** to create the .OPK file.

***Note:** The file name extension must be .OPK. You do not need to enter this extension as Origin will add it automatically. If you enter an extension other than .OPK, .OPK will be appended on the file name.

For installation information, see *Installing the .OPK File* on page 679.

Installing the .OPK File

Successful OPK file installation may depend on your ability to meet the file creator's **For Use By** restrictions for the .OPK file. Access restrictions -- if any exist -- are set in the **Export Button Group** dialog box. This dialog box is opened by clicking the **Export** button on the **Button Groups** tab of the **Customize Toolbar** dialog box.

To install the .OPK file, do **one** of the following:

- Double-click on the .OPK file.
- Drag the .OPK file onto the Origin program workspace.
- Hold down the left mouse button and drag the .OPK file onto the Origin program button on the taskbar (Origin is minimized). When the Origin workspace is restored, drag the .OPK file to the Origin workspace and release the mouse button.

When you perform one of these three operations, the .OPK file will install into the specified installation of Origin. If you double-clicked on the .OPK file, the .OPK file will install into the most recently run installation of Origin (if you have multiple installations).

During the .OPK installation, two things happen:

- The custom button group is added to the **Groups** list box on the **Button Groups** tab of the **Customize Toolbar** dialog box (**View:Toolbars=>Button Groups** tab).
- A toolbar containing the buttons from the custom button group is automatically created in the Origin workspace.

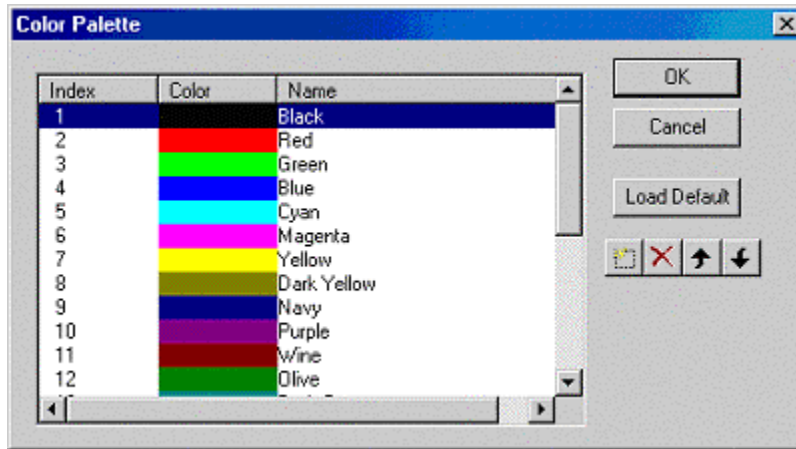
Note: When you install the .OPK file, Origin will save the custom files so that it maintains the folder structure that existed when the .OPK file was created. For example, if the custom button group's initialization file, bitmap file, script files, and other support files were saved in a \CUSTOM subfolder of the Origin program folder when the .OPK file was created, this \CUSTOM subfolder will be created in the "target's" Origin program folder. The custom button group's files will also be saved to this \CUSTOM subfolder.

Customizing the Color Palette

Color options are generally available from either:

- **buttons.** The color buttons provide a number of color control options, including selecting a color from the color palette, or incrementing through the colors in the color palette (see, Customizing the Colors in Your Data Plot).
- **drop-down lists.** The color drop-down lists display the colors from Origin's color palette.

The Origin color palette ships with 24 pre-defined colors. You can add up to 16 colors to the palette (for a total of 40 colors).





To customize the colors in the color palette:

1. Select **Format:Color Palette**.

This opens the **Color Palette** dialog box.

To change the order of colors in the color palette:


1. Select a color.
2. Click **Move Color Up**  or **Move Color Down** .

To customize a color in the color palette:

1. Click on a color in the **Color Palette** dialog box. This opens the **Color** dialog box.
2. Select a color from the **Basic Colors** gallery or click **Define Custom Colors** to define a custom color.
3. Make your changes then click **OK** to close the **Color** dialog box.


Your custom color displays at the same location in the palette. To associate a custom name with this color, *double-click* on the text in the **Name** column and name your new color.

To add a color to the color palette:

1. Click the **New Color**  button in the **Color Palette** dialog box. This action opens the **Color** dialog box.
2. Define your new color in this dialog box and click **OK**.

Your new color displays at the bottom of the color palette with the name **New Color**. Double-click on **New Color** to give a name to the color.

To delete a color from the color palette:

1. Select the color.
2. Click the **Delete Color**  button.

All the colors below this color move up one index level in the palette.

To reset the color palette to the default settings:

1. Click the **Load Default** button in the **Color Palette** dialog box.

Note: There are a couple of colors in this palette that are used globally by Origin to do such things as set background or default text colors (specifically, **black** and **white**). Changing the index numbers (1 and 18, respectively) of these two colors is not advisable.

Adding New Color Palettes to Origin

You can add new image palettes that are in Microsoft binary or JASC ASCII format and that are 256 color.

To do this:

1. Copy the file to the Origin \Palettes subfolder.

The next time you start Origin, these new palettes will display in the **Image:Palette** submenu.

You can create new palettes using any external application that writes the palette out in the Microsoft .PAL format. This is the only format that is recognized by Origin.

Additionally, Origin provides a palette editor project file located in the Origin subfolder:

\\SAMPLES\\PROGRAMMING\\PALETTE EDITOR\\PALEDIT.OPJ

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